Index Supplement to the Electrical Review,
July 2nd, 1897.

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## THE PROSPECTS FOR 1897.

THERE is a time honoured custom observed in many newspaper offices of declaiming fitting obsequies at the decease of the Old Year. This philosophic habit of taking a Bird's Eye view of things may be as harmless as smoke; we have fondly thought that there were still some readers left to whom this summarising of events were as Balm in Gilead. We are sorrowfully aware that it is the fashion among master minds to decry leaders of all descriptions, but surely these efforts to cast down an ancient institution have a tendency towards socialism, nay, savour of rank anarchy.

In our scan of matters we are limited to what has occurred in the electrical world. We have sought, however, this year to take a wider survey, and make some forecast for the coming year; we are ready to admit that we do not venture on rash prophecies in saying that there never were more hopeful prospects before the electrical industry.

In speaking of the prospects for 1897, it is as difficult to avoid reference to the past 12 months as it was for Mr. Dick to suppress the head of King Charles. Indeed, to take a correct view, one must, to some extent, be guided by what has happened during 1896, for the carry over must in itself be sufficient to keep most workshops busy for some months to come. There is every reason for the electrical industry to be satisfied with the position of affairs at the moment. The generally healthy tone that has prevailed throughout most industries has been manifest in electrical work. We do not say that the result of the year's work among electrical manufactories approaches the extraordinary activity of the Iron and Steel Trades, whose exports stand at close upon four million sterling higher than they did in 1895; but it can be claimed that substantial business has been done. Messrs. Bolling & Lowe, in their *Trade Review*, speaking of the iron and steel trades, say :—

"The character of the trade of the present year (1896) has not been that of a "boom" which means a sudden and sharp rise, but, on the contrary, a gradual and steady increase in values of both raw materials and manufactured articles; this we consider to be a most promising feature." Similar words would have admirably set forth the condition of the electrical industries. In speaking of the past accomplishments and the future developments, we are not relying alone on our own observation, for we have obtained opinions from many of the principal firms. One prominent company inform us "that they find their energies taken up with the work in hand . . . for some portion of the year we shall be occupied with the execution of contracts now in hand without taking any account of new ones." From one of the oldest firms in the country the following opinion is worth quoting, because it shows in what directions activity is likely to prevail :—

The distribution of power in factories and works of all kinds by means of electrical plant is rapidly becoming an important factor in our business, and we are indebted to this, more than to any other single development, for the orders in hand, which will keep our new works and increased capital fully employed for some months to come.

We consider that the demand for electric plant for traction purposes is likely to prove a much more important factor in the next year's business, and we are expecting to do a much increased trade in South Africa and Australia.

There is a steady improvement in the discrimination of buyers, which tends to the advantage of the high-class makers, and, taken altogether, we consider the prospect in our own special business better than it has been for some years past.

There is very little doubt that the expectations of manufacturers are based, to a great extent, on the development of electric transmission, and that their hopes are well founded may be gathered from the fact that "Motor Starting Switches, Regulators and Resistances, which a year or two back used to be reckoned in cwts., are now turned out by the ton." Although everybody recognises the importance of electric traction, it would appear that even if traction schemes are not rapidly developed during the next twelve months, yet there will be abundance of work.

We are glad to note that the manufacturers will be in a better position to supply foreign markets than they have been for some time, and there will be large consignments of plant abroad, notably to South Africa and other British Colonies. Cable makers are sharing in the general prosperity, and one prominent Company state that:—"As far as we ourselves are concerned, the puzzle is to cope with the orders that we have in hand. Our factory has been working both day and night for the past four months, and in spite of the fact that new plant is being put down as rapidly as possible, we continue to have the utmost difficulty in complying with the requirements made upon us."

Engine makers are in many cases unable to cope with the orders given to them, and this fact alone is an indication of such an amount of business as should ensure them considerable profits for 1897. The makers of switches, accessories, and the minor but important details of plant, are not troubled with the lack of work, their constant worry is how to execute orders.

## BLOCK SIGNALLING.

At the Railway Exhibition at the Imperial Institute last year, Mr. W. S. Boult showed a working model of a magnetic method of signalling to passing trains, which we noticed in the Electrical Review. Recently the inventor has had a trial apparatus, a description of which he sent us some weeks ago, in regular work.

The idea of generating an electric signal by means of permanent or electro-magnets laid by the side, or in the immediate neighbourhood of the railway metals, on the passage of a railway train or vehicle over the spot, is in itself not new; but there is, so far as we are aware, novelty in the mode in which Mr. Boult has adapted this means to the purpose in view.

Broadly, Mr. Boult arranges in the track of a train at any given point magnets—permanent or electro—which he manipulates from a near signal box in such a manner as to cause them, when passed over by a vehicle equipped with the necessary apparatus, to evolve a current in one of two directions. This current actuates a relay, and the relay actuates a bell. The magnets placed in one position generate —say a positive—and in the other a negative current. The position or arrangement of the magnets may be contingent upon the position of the signal ordinarily employed for the guidance of the engine driver, or it may be actuated independently. It will be obvious that these two polarities may be used to form any two signals, such as "line blocked" or "line clear."

On the locomotive the apparatus for taking up and rendering these indications is fixed; and as will be gathered from what has already been said, this apparatus embraces a relay, a bell, and a battery. A complete set of the parts composing one end of a block section, and the necessary accompaniments for a locomotive, has been experimentally installed on the Manchester, Sheffield, and Lincolnshire Railway, and is reported to be working in every way satisfactorily.

The principle aimed at is to convey directly to the driver the signal that shall be his guide—whether he may proceed or not. It is not quite clear whether it is intended to supersede the present form of signal post, or to supplement it. The decision on this point is, no doubt, judiciously left to the determination of those who may be disposed to avail themselves of it.

The question which will first present itself is: In what way will such an invention—ingenious as it unquestionably is—prove of utility? The railway service throughout the country is already clothed with a block system. If it is intended that the invention shall be supplementary to this, then will arise the question whether it is necessary, and whether, assuming it may be implicitly relied upon, is it judicious to employ two forms of signals, and so reduce the responsibility which attaches to the existing form of signal? The inventions which have from time to time been brought forward for communicating directly with the driver, between drivers of running trains, and between drivers and signal boxes or station masters, although not based upon the principle pursued by Mr. Boult, are numerous enough, yet it is, perhaps, notable that not one has found a footing; the what may be termed, orthodox system—the established system of block signalling still remains the means by which the trains are worked. It cannot be doubted that there are sound reasons for this. No doubt objections exist to the introduction of novelties, but railway companies, as a body, have not shown themselves averse to adopt that which possesses undeniable advantages; and if those inventions which, preceding Mr. Boult's, and aiming at a somewhat similar result, have so far failed to secure support on the part of any one company, we may reasonably conclude that some principle underlies this disregard.

This principle is, perhaps, not far to seek. Automatic signalling has never been encouraged by British railways. It has always been felt that the safety of the travelling public demands individual responsibility in the movement of railway trains. Automatic signalling has for years been employed in the regulation of trains on many of the American lines, but the conditions attending railway traffic in the United States are very different to those which attach to English lines. The distances between stations is greater. To establish block sections worked by hand would entail large outlay. With us, here at home, the stations, as a rule are in close proximity, and, quite independent of the signalling, *i.e.*, so far as the block section are concerned, there must be established "point" levers and other appa-

ratus protecting and controlling siding connections, &c., all calling for the presence of a responsible man for the conduct of such operations. On branch lines, where the traffic is not great, it is possible automatic signalling, if established on safe principles, might prove of some service. If failure, leading to stoppage of traffic, should arise, its effect would not be so serious as if such stoppage arose on lines filled with trains. Herein we, no doubt, see the reason for that general disregard which has attended the efforts of so many who have sought to induce railway companies to adopt automatic signalling. If automatic signalling could be regarded as infallible the result might be different. It is the possibility of failure, however remote, which has led to its rejection.

At the same time there is a period in railway working when a method of conveying to the driver of a train the fact that the signals are against him is necessary. During the winter months fogs frequently prevail to such an extent, as to render the signals invisible. Detonators have then to be laid upon the metals, and the driver, on passing over them, is warned by a loud report that the signal is at danger. The question will arise: Is it not preferable to show the driver, by a signal on his weather-board, that such is the condition of things, than to alarm passengers or residents near the line of railway by the repeated explosion of these fog signals? We are of opinion that, given a perfectly reliable means of so doing, and one which may be brought into use only during the existence of fog, there is much in its favour. The objection to its use as an adjunct to the general form of signals will, however, at once present itself to the mind of the reader. There cannot be two classes of signals by which the driver is to be controlled—one on the engine, the other on the line. One of these must be his guide. Clearly that one must be that which is visible to the man who is responsible for working it. Such a system as Mr. Boult advocates would be useful, if perfectly reliable, in cases of fog, when the signals on the line are not visible, but there must be unquestionable reliability, and in considering this we have to bear in mind that each engine requires to carry apparatus which calls for periodical attention and adjustment, and which should not only be capable of proof before the vehicle upon which it is placed leaves its depôt, but equally so *en route*. We do not despair of the achievement of this, although it must be granted that a locomotive engine thundering along an iron road intersected by numerous points and crossings is not the most evenly balanced or desirable domicile for such apparatus.

The system, if for adoption, must necessarily be applied throughout, *i.e.*, it must be fitted to the entire locomotive stock. Its adoption as an automatic system, we think, in common with all other similar systems, improbable. Its possibilities lie in its employment as an adjunct to the existing type of signalling, and that chiefly in case of fog. If its employment in this sense, subordinate to the dominant form of signal, can be incorporated, we think it may be useful. By this we mean its employment, so that when the general form of signal is visible, that alone shall be the signal by which the driver is to be governed; and that for the reason, as has been previously stated, because it is a signal observable by the man who works it, and is responsible for the safe passage of the train, as well as by the driver of the train, for the protection of which it is provided; but when this signal is, from fog or other causes, obscured from view, that the warning afforded by this supplementary signal shall not be ignored by the driver. Whether such a condition can be recognised—whether it is possible to admit the control of two forms of signal—is a question for the careful consideration on the part of railway authorities.

We do not quite follow Mr. Boult in his remarks on junction working. As we understand the question, the junction signal box controls the movement of the approaching trains, holds certain trains back until the road for them is clear. It is not for the trains to select their route, and having done so, to announce to the signalman what they have done. We have possibly misunderstood this portion of Mr. Boult's description, but such is what we gather from it.

Much is said of the present mode of signalling in comparison with that advocated. Electricity has proved unquestionably of the greatest value to railway working. Without its aid, or something which could equally well take its place—and it is difficult to see in what way this could be accomplished—it would be utterly impossible to conduct the railway service of the country in the satisfactory manner in which it is at present dealt with. Electricity is no doubt destined to be of still further service, and possibly in the direction of Mr. Boult's invention, to which we wish every success. But it must not be forgotten that the existing conditions—although, no doubt, open to improvement—is the outcome of that which has, by those responsible for the satisfactory working of the various systems which form the railway service of the country, been thought most fit for the purpose.

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**A Large Electric Launch.**

As though to commemorate that foolish book "Utopia," Mr. John Jacob Astor has had built a large electric launch and called it the *Utopian*. It is worth notice from its size, 72 feet long by 12 feet beam, the draught being 4 feet. The power is derived from an accumulator of 408 cells, each of 300 ampere-hours capacity. There are two motors and the accumulators for each are made up in six sets of 32 cells each, made by the Samuels Dynamic Accumulator Company. The *Electrical World*, to which we are indebted for our facts, describes the positive plate as a solid piece of active material which is by a "*peculiar* chemical construction" as hard and dense as marble, and improves with age. The cells contain no grids, nor is any lead nucleus present. The above solid plates are formed in 14 hours, and the process is very cheap. Twenty-six pounds of active material go to form a 300-ampere cell of 11 plates, and one cell weighs 50 lbs. As 384 cells go to the power batteries, their total weight is 19,200 lbs., so that the two motors capable of driving the boat at 16 miles per hour weigh less than 4,000 lbs. and develop 25 H.P. each. The armatures each weigh 1,168 lbs. and are of large diameter; they run at 1,000 revolutions per minute and drive three-bladed 34-inch screws, which are placed well under the stern of the boat in solid water. The motor fields can be connected up either in parallel or series with each other; they are in series with the armature winding. There are eight speeds ahead with voltages of 34, 68, 102 and 204 in series and multiple, and four speeds are similarly arranged astern. The motors were built by the Riker Company, of Brooklyn. We are glad to note that this fast boat is intended to ply at Newport, and not on our little Thames, or we fear Mr. Astor would have the power to make himself as disagreeable on the water as he succeeded in doing on the banks at Clieveden. Though not stated, we conclude the remaining cells are used to drive the capstan motor, which also drives the air compressor of the whistle.

## LOCALISING EARTH FAULTS IN SUBMARINE CABLES BY TESTS FROM ONE END ONLY.

By J. RYMER-JONES.

THE importance of a simple and reliable test when the cable conductor is broken and offers a very small surface of exposure is fully recognised, and probably by none more than by electricians of cable repairing steamers, whose tests are perforce hurried at times by untoward appearance in the weather, and more frequently, perhaps, by the anxious importunities of the cable engineer responsible for the safety of the cable hanging from the ship's bow.

Even when a fault is not a *total* rupture of the conductor, the absence of a sufficiently skilled co-operator at the distant end to assist in testing often necessitates a *partial earth* being dealt with as a complete break, since tests from the ship—or from one end only—have to be depended on for localising the fault's position.

Several good tests have been invented to suit these particular conditions, notably Mr. H. Kingsford's modified Blavier test for a *partial earth*, while for a total break—and *partial earth* also—incomparably the most reliable methods are those devised by Mr. A. E. Kennelly, whose well-known law of *inverse square roots* has enabled a broken conductor exposed to the water to be localised with much greater exactitude than was previously possible (see "Resistance of Faults in Submarine Cables," published in the *Journal* of the Society of Telegraph Engineers and Electricians in March, 1887).

The uncertainty, however, of determining the *exact* false zero, to which all measurements had to be made by his first method, and which is, to a great extent, obscured when testing a long cable by the discharge, and also by the polarisation current decreasing rapidly in strength as soon as the testing current is taken off, induced Mr. Kennelly to extend his investigations in connection with this kind of fault. The results have been embodied in two more useful tests, with formulæ of a similar character, inasmuch as both these tests necessitate *three* bridge measurements to *instrument zero;* the first test with battery powers in the ratio of 1—4—9, and the second test in the ratio of 1—4—16 (see *Electrician*, October 14th and 21st, 1887).

While engaged in a series of tests on experimental faults, which the writer initiated for the purpose of determining the proportional variation in the apparent resistance of different conductor exposures, when employing *three* testing current strengths in the relation of 4 — 2 and 1, Mr. Herbert E. Cann, of the Silvertown Submarine Electrical Department, noticed the important and interesting fact that under these conditions an even closer approximation to the actual position of a break, than by the Kennelly formulæ, can be obtained with the following formula:—

$$\text{Distance of fault} = A + B - C \text{ units,}$$

where

A = measured resistance with the strongest current.
B = " " " intermediate current.
C = " " " weakest current.

A series of tests published in the ELECTRICAL REVIEW of December 17th show the comparative results obtained by Mr. Kennelly's and Mr. Cann's formulæ.

While engaged in a further perusal of these and other later tests, and in comparing the resistance variation of different exposures under testing currents in the proportion of 4 — 2 and 1, the writer elicited from them certain interesting points which he has turned to practical use.

The results of upwards of a hundred tests show that although the differences in the *apparent* resistance of the same exposure increases considerably as the battery power is decreased; yet if the three testing currents be in the proportion of 4 — 2 and 1, the difference between the measured resistance obtained by the first two tests (B — A) will be to the difference between the second and third test (C — B), as 0·5576 to 1.

This proportion is found to hold good both for widely different current strengths, and also for large and very small exposures.

It will be obvious, therefore, that instead of *three* tests, as required by Mr. Kennelly's and Mr. Cann's formulæ, only *two* tests are necessary, because the *third* value may be calculated from the difference between these two measured resistances, since the ratio between C — B and B — A is a constant quantity for all exposures, and under widely different current strengths.

Thus 0·5576 (C — B) gives the difference between B and A, so that A need not be measured.

Mr. Cann's formula may therefore be simplified as follows:

$$\text{Distance of fault} = B - 0{\cdot}5576\,(C - B) + B - C$$
$$= 2{\cdot}5576\,B - 1{\cdot}5576\,C.$$

It will be apparent, from the above considerations, that this test provides all the requisites for eliminating the *apparent* resistance of a fault by means of only *two* measurements, while it retains the important advantage of allowing the balancing to be made to *instrument* zero, to secure which Mr. Kennelly had recourse to *three* measurements.

Additional certainty is secured by first measuring B, then C, and immediately afterwards again measuring B. If the last value agrees with the first, the operator has the satisfaction of knowing that the test can be relied on; should there be any difference, he had better take a second observation of C, and compare the results obtained from the two *pairs* of readings.

The following advantages are secured by this simplification of the test.

(*a*) To give the same results, the maximum testing battery need be only $\frac{1}{2}$ that employed by Mr. Cann and $\frac{2}{3}$ths and $\frac{1}{3}$th respectively of that required by the Kennelly formulæ.

(*b*) As the testing current employed is relatively very small, an inconstant battery does not run down during the test to any important extent, and thereby introduce disparity in the measured resistances; nor is so much gas set free at the fault to cause disturbance as when using battery powers widely different in strength. This is especially important when localising a fault of very small exposure.

(*c*) When a limited number of cells is available for testing, a fault can be localised at a much greater distance.

(*d*) As only *two* measurements are necessary instead of *three*, the test takes less time, and the chance of the fault changing in the interval, or *earth currents* varying, is considerably reduced. The latter consideration is important, since the balances are all made to *instrument* zero.

(*e*) Since the third quantity (A) is calculated from the difference, C — B, possible errors of observation, or changes referred to in paragraphs *b* and *d* are avoided, and more reliable results obtained.

(*f*) Another advantage, to be explained later, is that the *difference* between the measured values, B and C, indicate whether the result may be depended upon, or whether any correction is necessary.

The results of a large number of tests show that for exposures varying from 1 inch to $\frac{1}{8}$th inch, the calculated results are closely the same. Reducing the exposure to $\frac{1}{16}$th inch increases the calculated resistance to the fault by about 5 units only; while for a cut with pliers, the result works out about 20 to 30 units more.

This is only what might be expected, because a clean cut has really a higher resistance, on account of the resistance of the water at the point of contact.

This resistance must be distinguished from the *apparent* resistance from polarisation.

For example:—If the conductor is broken inside the core, so that the dielectric envelope forms a tube over it, into which the sea water can enter, although the contact surface between the water and conductor end may be the same as in the case of the clean cut above referred to, the calculated distance of the two faults will differ considerably; because, while the clean cut makes contact *immediately* with a vast expanse of water, in the other case under consideration the water in the dielectric tube is interposed, and adds its resistance to the measured result. For the same reason an important error would be introduced into the result if the broken end (or bared conductor surface) be encrusted with any substance offering a resistance. Kennelly's law applies only to clean surfaces, and the variation under different current strengths of the measured resistance between the exposed conductor and the sea; so that any intervening material—whether it takes the form of a liquid or solid incrustation—will vitiate the result, and no formula or test

has yet been suggested whereby the resistance of the copper conductor can be distinguished from any other resistance (whether solid or fluid) in circuit with it.

A certain amount of assistance may, however, be derived from the following considerations :—

If the exposure be so small as to offer an important resistance, the fact will be observable when testing by the unsteadiness in the balance produced by the evolution of hydrogen gas caused by the higher testing current. When this current is limited to the number of milliamperes hereafter specified, any unsteadiness in the balance (unless it arises from varying *earth currents*, which are, as a rule, distinguishable owing to their being much less rapid and continuous) will show that the fault has a real resistance, and 20 or 30 units may with safety be subtracted from the calculated distance. There is, however, another means of judging whether the fault has a high resistance.

It is found that not only does the difference between the two measured resistances, B and C, vary considerably with the battery power used for testing, but the difference is also very marked with faults having different surface exposures, even under the *same* testing current.

The weaker the testing current, the more observable is this difference. For example: When testing core having a stranded conductor of seven No. 22 gauge wires, weighing 107 lbs. per N.M., and a gutta-percha covering weighing 140 lbs. per N.M., if the currents through the faults for B and C be, respectively, 10 and 5 milliamperes, the *differences* in the measured resistances are as given in Test 4. If 20 and 10 milliamperes be used, the differences will be as in Test 3.

Suppose, therefore, that the two testing currents used be 10 and 5 milliamperes, and the *difference* between the measured resistances be no more than (say) 83, it will be evidence that the fault resistance is unimportant, and that the calculated distance may be relied on. If, on the other hand, a difference of 91, or more, be obtained, it will be safe to subtract 25 units for the resistance of the fault. In the case of a larger difference still, it will be well to clean the fault with a strong *negative* current and then to test again. Should the unsteadiness of the balance show that the surface exposed be very small, a positive current applied for a minute or so, before repeating the above test, will sometimes give a steadier result. Putting a *positive* current for a minute through a cut made with pliers gave a steadier test, and reduced the *difference* between B and C to about that obtained with the $\frac{1}{4}$-inch exposure, but did not reduce the calculated resistance very greatly.

It is advisable, therefore, to first note the difference between B and C under the two zinc testing currents in order to apply the correction, in case it is found advantageous to apply a *positive* current for a short time to a very small exposure before repeating the localisation test with zinc currents.

Before starting any test, it is advisable to clean the fault with a strong negative current, in order that the cleaning process may not interfere with localisation tests. This advice, however, applies to all faults of the nature referred to in this paper, irrespective of the particular test or formula employed.

A fault which cannot be satisfactorily localised by this test had better be sealed with a positive current, and its position found by a capacity test.

When testing very long cables, the testing current should be kept on for two minutes to allow the fall to become regular, and the polarisation steady, before observing B. This is especially important when a long length of cable is coiled in the ship's tanks.

Arranging the battery powers so that the change from the higher to the lower current may be made quickly by a switch or plug commutator, without taking the current off, and putting the cable to *earth* between the two measurements, is advisable. On this account an additional advantage arises from being able to balance to *instrument* zero instead of to false zero; since in the latter case time is wasted after every observation of the false zero, while waiting for the fall to become regular; and the degree of polarisation will not always remain constant for repeated measurements. But, apart from this consideration, the time required for balancing to *instrument* zero is only a very small fraction of that necessary for balancing to *false zero*.

We have been considering faults in core $\frac{107 \text{ lbs. conductor}}{140 \text{ lbs. g. percha}}$ but for a different size of core the *differences* between B and C for various exposures may be found by experiments on a piece of the core immersed in sea water. After finishing the localisation tests, a resistance equal to B should be joined up in circuit with the piece of experimental core, and an artificial fault of (say) $\frac{1}{8}$th inch exposure tested with the same two current strengths as applied to the cable to test for the real fault.

As core is not always available at a shore station, a table of differences may easily be made for future reference for (say) $\frac{1}{8}$th inch conductor exposure for any particular core. A table of *differences* for all current strengths from a maximum of 30 and 15 milliamperes, to a minimum of 10 and 5 milliamperes will suffice for all practical purposes.

In the majority of faults the exposed conductor will be sufficient to insure a true result *without any correction*, provided the current strengths be 20 and 10 milliamperes.

The calculated results of a large number of tests show that although very approximate results may be obtained for exposures of 1 inch to $\frac{1}{16}$th inch when the currents through the faults are for B and C respectively as high as 40 and 20 milliamperes, the results will be rather too high, and it is therefore preferred to use 20 and 10 milliamperes; or even 10 and 5 milliamperes. Both pairs will, for these exposures, give close results.

Currents of 10 and 5 milliamperes will give the same accuracy as 20—10 and 5 in Mr. Cann's formula; but these results generally work out about 10 units too low for large exposures; while 20 and 10 milliamperes give very exact results. This would be equivalent to 40—20 and 10 milliamperes, supposing *three* testing currents were employed.

Testing with strong currents causes the measured resistance to creep up several units more than with the lower testing current, and the result is consequently less reliable.

If much weaker currents than 10 and 5 milliamperes be used, the localisation generally comes out rather low.

In the case of a clean cut with pliers, the gutta is rather compressed over the conductor, so that a very small surface is left exposed to the water. For such a fault it is not desirable to use stronger currents than 10 and 5 milliamperes, as the formation of gas at the fault would make it rather difficult to obtain a really reliable balance. Moreover, the difference between currents of 20 and 10 milliamperes, and 10 and 5 milliamperes, is tolerably constant for all exposures from 1 inch to $\frac{1}{16}$th inch, and if 10 units be added to the results obtained with 10 and 5 milliamperes, it will agree very closely indeed with results obtained with 20 and 10 milliamperes, so that 10 and 5 milliamperes may be taken as the fixed values of the two testing currents, and the formula becomes:

Distance of fault $= 2{\cdot}5576\ \text{B} - 1{\cdot}5576\ \text{C} + 10$ (units).

A convenient formula for calculating a suitable battery is

$$\left.\begin{array}{l}\text{Number of cells for}\\ \text{maximum testing}\\ \text{current } (c)\end{array}\right\} = \frac{n\,[\text{R} + p]}{1000^{\omega}\,e} \text{ or } n = \frac{1000^{\omega}\,c\,e}{\text{R} + p}$$

where

$e$ = E.M.F. of a *single cell* of the battery used in volts.
$n$ = Number of milliamperes required for the maximum current.
R = Resistance obtained by a preliminary measurement of the cable, balancing to cable current (or *false*) zero, and using any suitable number of cells—zinc to the cable.
$p$ = Proportional resistance, in cable branch of bridge, used for localisation test. This should be always kept at $1000^{\omega}$.
$c$ = Number of cells for maximum testing current.

The number of cells which is divisible by 2, nearest to the answer, must be used to measure B, and half this number to measure C.

NOTE.—Use 1,000 to 1,000 in bridge branches when measuring B and C.

*Example.*—If $n = 10$ milliamperes; $e = 1{\cdot}40$ volts; $\text{R} = 2{,}000^{\omega}$ and $p = 1{,}000^{\omega}$

$$\text{Number of cells} = \frac{10\,[2{,}000 + 1{,}000]}{14{,}000} = 21{\cdot}4 \text{ cells.}$$

Therefore 22 cells are to be used for measuring B, and 11 for C.

If the battery be in good condition, it may safely be assumed that the E.M.F. will be in proportion to the number of cells.

If a preliminary test shows that the resistance in circuit is less than 1,000 units, it will be well to put about 1,000 additional units in circuit with the cable; so that the difference in the resistance of the fault when testing with the half battery may not materially alter the ratio 2 to 1 in the current circulating through the fault when measuring B and C. Any available coil with moderately high resistance will do for the purpose, as its resistance may be measured and afterwards subtracted from the result.

The following tests will illustrate what has been already explained:—

TEST 1.

*Test on artificial cable,* C B = 826. *Capacity* = 97·7 *microfarads.*

| Exposure. | 20 cells = 16 ma. B | 10 cells = 8 ma. C | Differences. | Results. |
|---|---|---|---|---|
| 1 inch | 880·5 | 920 | 39·5 | 819· |
| ½ " | 898 | 948 | 50 | 820· |
| ⅛ " | 912 | 972 | 60 | 818·5 |
| 1/16 " | 922 | 987 | 65 | 820·8 |
| Cut | 947 | 1,009 | 65 | 842·8 |

TEST 2.

*Test on artificial cable,* C B = 1,657. *Capacity* = 196 *microfarads.*

| Exposure. | 30 cells = 16 ma. B | 15 cells = 8 ma. C | Differences. | Results. |
|---|---|---|---|---|
| 1 inch | 1,710 | 1,748 | 38 | 1,650·8 |
| ½ " | 1,727 | 1,774 | 47 | 1,653·8 |
| ⅛ " | 1,741·5 | 1,799 | 57·5 | 1,652 |
| 1/16 " | 1,748 | 1,807 | 59 | 1,656 |
| Cut | 1,786 | 1,848 | 62 | 1,689·5 |

TEST 3.

*Test through resistance coils* = 1,500$^{\omega}$.

| Exposure. | 36 cells = 20·6 ma. B | 18 cells = 10·3 ma. C | Differences. | Results. |
|---|---|---|---|---|
| 1 inch | 1,544 | 1,573 | 29 | 1,499 |
| ½ " | 1,561 | 1,601 | 40 | 1,499 |
| ⅛ " | 1,571 | 1,614 | 43 | 1,504 |
| 1/16 " | 1,582 | 1,629 | 47 | 1,509 |
| clean cut | 1,609 | 1,655 | 51 | 1,537 |

TEST 4.

*Test through resistance coils* = 1,500$^{\omega}$.

| Exposure. | 18 cells = 10·3 ma. B | 9 cells = 5·15 ma. C | Difference. | Results. |
|---|---|---|---|---|
| 1 inch | 1,573 | 1,627 | 54 | 1,489 |
| ½ " | 1,601 | 1,675 | 74 | 1,486 |
| ⅛ " | 1,614 | 1,697 | 83 | 1,485 |
| 1/16 " | 1,629 | 1,718 | 89 | 1,490 |
| clean cut | 1,655 | 1,746 | 91 | 1,513 |

The following results will be instructive as a proof that the actual resistance of even a very small surface of clean conductor exposed to sea water has a very small resistance, and that the apparent resistance is almost entirely due to polarisation:—

*No.* 18 *Copper Wire Covered with Gutta Percha to No.* 7 *Gauge in Circuit with* 1,500$^{\omega}$. *Tested with* 10 *and* 5 *milliamperes.*

| | Calculated. | | Calculated. |
|---|---|---|---|
| 2 inches exposure | = 1,490$^{\omega}$ | ⅛th inch exposure | = 1,497$^{\omega}$ |
| 1 inch " | = 1,489 | 1/16th inch " | = 1,502·5 |
| ½ inch " | = 1,490 | 1/32nd inch " | = 1,514 |
| ¼ inch " | = 1,490 | clean cut " | = 1,536 |

NOTES.—The differences show the relative values of the fault resistance, which was only 46 units in the case of a clean cut. As already explained, the calculated results for large exposures work out about 10 units less than with 20 and 10 milliamperes.

From the foregoing results, and for the reasons explained, it will be seen that the test is capable of great accuracy when results from one end only have to be relied on to determine the position of a *partial earth* or broken conductor.

## ECONOMISER TEST AT A TRAMWAY POWER STATION.

THE use of the "economiser" type of feed water heater which some of our English electrical engineers erroneously believe to be of little good, has been steadily growing in America since first introduced from England. Some tests recently made at Holyoke have been described in the *Electrical Engineer* of New York by Mr. S. M. Green, who reports very favourably upon the results. The plant at the station consists of three water-tube boilers, with a total of 6,177 square feet of heating surface. They supply steam to three compound engines of 400 H.P. each, with cylinders 15 inches and 28 inches by 48 inches, and there is an induced fan-created draught with a pair of 8 feet diameter fans. It is to be noted that the feed-water first passes through a coil of pipe of 135 square feet area, placed in the path of the exhaust steam to the condensers. It next passes through a coil of 500 square feet area, which is heated by the exhaust of the fan engines and feed pumps. Possibly these exhaust to the atmospheric pressure, and the steam will thus measure about 100° temperature at the first coil, and 212° at the second.

The use of these coils is good practice in every sense. In the first place they should improve the vacuum; next they should save condensing water; but perhaps better than these they should serve to heat up the feed to a fair temperature before it enters the economiser. It is well known that unless this be done the lower ends of the economiser pipes become very rapidly wasted by corrosion, and this is simply due to the condensation of acid vapours from the smoke by the cold tubes. Practice has shown that where the water is cold about a sixth of the heated feed ought to be returned to the feed pump so as to raise the cold feed to a temperature sufficient to prevent condensation. The use of the coils above-named probably serves the same end with better economy. At Holyoke the economiser contains 288 tubes. These aggregate 3,550 feet of heating surface, and contain 2,000 gallons of water. We reprint the main figures in full:—

| | |
|---|---|
| Average temperature of flue gas at boiler ... ... | 387° |
| Average temperature of flue gas at stack ... ... | 246·6° |
| Average temperature of feed water entering ... | 44° |
| Average temperature of feed water in primary heater | 101° |
| Average temperature of feed water in secondary heater | 207° |
| Average temperature of flue gas in economiser ... | 246·2° |
| Draft at boiler, inches of water ... ... ... | ·08" |
| Draft at stack, inches of water ... ... ... | ·09" |
| Coal consumed ... ... ... ... ... | 10,100 lbs. |
| Combustible consumed ... ... ... ... | 9,995 " |
| Ash ... ... ... ... ... ... | 805 " |
| Water evaporated ... ... ... ... | 99,197·5 " |
| Water evaporated per pound of coal... ... | 9·82 " |
| Total watt hours ... ... ... ... | 2,965,000 |
| Average watts per hour ... ... ... | 157,461·0 |
| Average electric H.P. per hour ... ... | 212·08 |
| Duration of run... ... ... ... | ...18 hrs. 50 min. |

They show that the average feed temperature was 207°, and that each coil heater practically raised the feed water to the exhaust steam temperature. The accession of temperature in passing through the economiser was apparently not noted, but the waste gases lost about 141°. This is considered by Mr. Green to represent a 3½ per cent. economy. It seems to us that even with a furnace temperature so high as 2,500°, the saving is more nearly double the amount stated. However, even 3½ per cent. represents 6 per cent. upon the cost of the economiser, and if the output were double of the plant, the return would be 12 per cent., or even more, for there would be more heat coming over from the boilers, and the feed water would be made so much hotter. The objection to the economiser in the London district has been largely due, it may be supposed, to the incrustation from the chalky water so very commonly used. This ought not to be allowed much weight. The tubes of an economiser are very easily bored out clean, and if it pays to make an almost universal use of the appliance in the manufacturing districts where coal is cheap, it ought certainly to pay where coal is double the price. The use of feed coils in the exhaust of steam pumps should also be far more common.

## THE NIAGARA-BUFFALO TRANSMISSION.

AN ordinary contributor to a journal of standing and solidity cannot hope to emulate the brilliant coruscations of style that flashed through the report quoted in a recent issue, of the successful opening at Buffalo of the power transmission line between that city and Niagara Falls. For all that, however, it may be worth while commenting upon the affair in staid matter of

fact prose, and noting some of the technical particulars which have, or should have, interest for our readers devoted to electric traction work.

First of all, we suppose this Niagara-Buffalo transmission must be allowed to take the leading place in regard to length of line over which the current passes. The Tivoli-Rome transmission is, perhaps, the furthest we have in Europe, in point of distance and size; but there are, and have been for some years, successfully at work quite a number of smaller lines operated from distances of a few miles, as, for instance, the Stanserhorn, Mont Salève, and Mürren railways.

The 26 miles of line between Niagara and Buffalo stand out prominently above the 12 miles from Tivoli to Rome, whilst all the others mentioned are quite short, not more, that is, than 8 or 10 miles at most. They serve, however, equally well to illustrate the great possibilities of using hydraulic forces for economical generation of current at high pressure, with transmission over any required distance.

It is typical of the United States that the Niagara transmission should be calculated on a large scale, both in the power transmitted and distance covered; also that the current should be used entirely for electric traction at the far end. The present contract calls only for 1,000 H.P. to be delivered, though this would be considered a splendid output for such a purpose in England, electric traction being in its present condition. Yet the conductor line just opened is designed for a capacity of 10,000 H.P. at 20,000 volts—double the voltage now employed (the entire apparatus being arranged so that the higher pressure may be used as the demand increases)—and three other such lines can be erected on the poles now installed. Buffalo, therefore, will be able to draw upon Niagara Falls for a total of 40,000 H.P. before any more poles need go up—a good enough margin, one would think this, for some time to come. So far we have nothing in Europe that aspires to a hundredth part of this amount, but then of course we haven't got a convenient hill for water to tumble down, same as Niagara.

We have already dealt to some extent with the leading features of this transmission line, such as the transformation at Niagara of alternating current from the big Niagara Falls turbine generators into three-phase current, which is stepped up for transmission to Buffalo, stepped down at the latter place and transformed into direct current at 550 volts, &c., and we need not, therefore, repeat them. The principal interest lies in the step up and down transformers and the pole line. The former were lately alluded to, and the similarity of their leading features to some of Ferranti's work at Deptford, in the early days of 10,000 volts, also noted. The pole line is novel, however, and probably unique. We are not, at any rate, likely to see much of the same sort of thing here, thanks to Board of Trade restrictions upon overhead wires. The Board of Trade, moreover, does not guarantee any interest on extra outlay in burying the wires, so that we labour under a double disadvantage in this country. The aspect of the Niagara-Buffalo line would doubtless grieve our æsthetic London County Council; but Messrs. Burns and Benn may be quite sure of one thing, and that is that they will not see the bare conductors used as clothes lines in the way they alleged trolley wires might be employed.

There are, in all, about 2,100 wooden poles used, ranging from 35 to 65 feet high, from 15 to 30 inches in diameter at the bottom, and from 9 to 10 inches at the top. These poles are set about 60 to 75 feet apart, are made of round cedar, shaved and painted dark green, according to one report, white according to another. The particular colour employed is, of course, a very important feature!!! The cross arms are two in number (each to carry three three-phase conductors on each side of the pole), are 12 feet long, and 4 inches by 6 inches, of hard yellow pine. The poles are set in the ground, from 6 to 8 feet deep, concrete being used where the earth is moist and soft. The conductors are completely transposed in position, every five miles, or five times in all, and specially high strong double poles are used at these points, also at curves and angles along the line, the cross-arms being fastened to both poles, which are, moreover, cross tied with a $\frac{3}{4}$-inch wire.

The conductors are each formed of a 19 strand cable, having a cross-section equal to 350,000 circular mils. The insulators have already been described—being of the triple petticoat pattern; they each weigh about 12 lbs., and are tested to 40,000 volts before acceptance. The cables measure in all about 78 miles, and weigh about 5,200 lbs. per mile. Transmitting 1,000 H.P. at 10,000 volts, the loss of voltage is not more than $11\frac{1}{2}$ per cent.

Starting from Niagara, the line runs for about 18 miles along a special right of way, 30 feet wide, duly fenced in, and specially bought for the purpose by the company. As might be expected, it does not follow a straight line, but has to dodge buildings, &c., and follow curves in several places. At the Buffalo end, five miles of line are taken along the banks of the Erie Canal, and three miles are within the city boundary. Nearly a mile of the latter is put underground in a subway of vitrified tile conduit in four layers of three each, the conduits having a clear inside diameter of 3 inches each. The whole four layers are surrounded by a 4-inch skin of concrete, and the top of the latter is at least 18 inches below ground level. Manholes are provided at intervals of about 250 or 300 feet. The underground cables are insulated with ·28 inch thickness of rubber, braided and lead armoured, and were tested to 40,000 volts before acceptance.

The transmission being all for one definite purpose and to a single terminus, the switch gear is naturally of a simple kind; but we hope later on to illustrate or describe it in detail, as also the lightning arresters—an item of no little importance in a long, overhead system like this. We understand at present that the Wurt type of arrester is employed, somewhat similar to those successfully used in the Western States for overhead transmission, but full details have not as yet been published.

## BOILER ACCIDENTS.

THE danger of expansion joints in steam pipes is referred to in a note in *Cassier's Magazine*. Two boilers are connected by a pipe between their junction valves. This pipe had a plain telescope or gland expansion joint in it. One boiler only being at work, the attendant shut down the valve of this boiler, and put in the pipe a blank flange preparatory to removing the valve from the boiler which was at rest; but he put this flange on the wrong side of the expansion joint, so that when he had unbolted the valve from the boiler, or partially so, the steam acting on the blank flange (the junction valve of the working boiler had been reopened after inserting the blank flange) blew off this end of the pipe, drawing off the gland piece from the plain end and allowing full steam to escape, and the man was killed; apart from this, showing up the careless want of thought in blanking the junction pipe at the wrong place, the arrangement shows bad design. There would always be a severe stress, tending to push the two boilers apart, and to break the joints of the valves upon the boiler, and it should be made a rule not to connect boilers by such short direct pipes as to require expansion joints of this dangerous form. If such a joint can even be considered imperative, there is no reason whatever why they should not be provided with safety bolts that would prevent the ends separating more than a fraction of an inch. These should, of course, be slack, and at the extreme position of the expansion should not have a play of more than about an eighth of an inch.

Another danger in boiler work has again been referred to by Manchester Steam Users' Association. The importance of letting all steam out of a boiler before loosening the manhole bolts, is emphasised. The safety valve ought to be propped up to ensure the entire absence of pressure. It is not meant that the lever be lifted and supported off the valve, but the valve itself. A 4-inch safety valve mushroom will weigh probably 6 or 7 pounds. Now this weight would require several ounces pressure of steam per square inch to lift it. Such a valve will serve to keep a pressure of steam inside a boiler of several ounces, and a pressure of only 5 or 6 ounces upon a manhole cover will far exceed the weight of the cover. But the red lead joint may hold the cover until the whole of the bolts are removed. Then a pry with the chisel sets the whole loose, and sufficient steam outrushes to scald the uncautious attendant. The writer was once scalded by an outrush of steam where the manhole had been removed and simply replaced without bolts. The safety valve was not propped, and the boiler was only slightly wet inside, and steam was raised to an ounce or two by the hot brickwork seatings, and was sufficient to rush out in a very ugly manner on prying up the manhole cover.

The lesson is to be sure that there is a free opening into the boiler before attempting to loosen a bolt. Open the glass gauge cocks, and be sure they are open. Prop the safety valve and not merely its lever. Don't rely on the blow out tap, because this ought very probably to be shut if there is an expectation of anyone going inside the boiler, for no one ought to enter a boiler with the blow out open unless there be no other boiler in connection. The good old fashion of having a cock upon the manhole cover seems to have died out since it has ceased to be wanted to prevent collapse from external pressure of a boiler with a partial vacuum inside. There ought to be such a tap still fixed. It ought to be suitable to take the engine indicator for checking the steam gauge, and it could be used to show when there was no steam in a boiler, or at least no pressure before opening up was commenced.

## APPLICATIONS FOR ELECTRIC LIGHTING PROVISIONAL ORDERS.

The following is a list of the applications deposited with the Board of Trade on or before December 21st, 1896, under the provisions of the Electric Lighting Acts, 1882 to 1890, for the 1897 session:—

| Title of order and description of area. | Name of promoters. | Agents. |
|---|---|---|
| Ambleside Electric Lighting Order. The Urban District of Ambleside. | The Urban District Council. | Messrs. Sherwood and Co., 7, Great George Street, Westminster, S.W. |
| Ballymena Electric Lighting Order. The Township of Ballymena. | The Town Commissioners. | Messrs. Dyson and Co., 24, Parliament Street, S.W. |
| Bangor Corporation Electric Lighting Order. The Municipal Borough of Bangor, and portions of the parishes of Llandegai and Pentir. | The Corporation of Bangor. | Messrs. Roberts and Chubb, 6, Queen Anne's Gate, Westminster, S.W. |
| Barking Town Electric Lighting Order. The Urban District of Barking Town. | The Urban District Council. | E. H. Lister, Esq., Clerk to the Council, Public Offices, Barking Town. |
| Bexhill Electric Lighting Order. The Urban District of Bexhill. | The Urban District Council. | Messrs. Rees & Frere, 5, Victoria Street, Westminster, S.W. |
| Bexhill Electric Lighting Order. Portion of the Parish of Bexhill. | Earl de la Warr and Robert Kersey, Esq. | J. C. Ball, Esq., 16, Parliament Street, S.W. |
| Brighouse Corporation Electric Lighting Order. The Borough of Brighouse. | The Corporation. | Messrs. Sharpe and Co., 9, Bridge Street, Westminster, S.W. |
| Bury St. Edmund's Electric Lighting Order. The Municipal Borough of Bury St. Edmund's. | The Corporation. | Messrs. Baker and Co., 22, Great George Street, Westminster, S.W. |
| Darwen Corporation Electric Lighting Order. The Borough of Darwen. | The Corporation. | Messrs. Sherwood and Co., 7, Great George Street, Westminster, S.W. |
| Denton Electric Lighting Order. The Urban District of Denton. | The Urban District Council. | Messrs. Sharpe and Co., 9, Bridge Street, Westminster, S.W. |
| Dorking Electric Lighting Order. The Urban District of Dorking. | The Urban District Council. | Messrs. Sherwood and Co., 7, Great George Street, Westminster, S.W. |
| Droylsden Electric Lighting Order. The Urban District of Droylsden. | The Urban District Council. | Messrs. Sharpe and Co., 9, Bridge Street, Westminster, S.W. |
| Dudley Corporation Electric Lighting Order. The Municipal Borough of Dudley. | The Corporation. | Messrs. Sharpe & Co., 9, Bridge Street, Westminster, S.W. |
| Dundalk Electric Lighting Order. The Borough of Dundalk. | The Town Commissioners. | Messrs. Hargreaves and Co., 18, Abingdon Street, Westminster, S.W. |
| Epsom Electric Lighting Order. The Urban District of Epsom. | The Urban District Council. | Messrs. Wilson and Genge, Norfolk House, Victoria Embankment, W.C. |
| Farnworth Electric Lighting Order. The Urban District of Farnworth. | The Urban District Council. | Messrs. Dyson and Co., 24, Parliament Street, S.W. |
| Galway Electric Lighting Order. The Urban Sanitary District of Galway. | Galway Electric Company, Limited. | Messrs. Valpy & Co., 19, Lincoln's Inn Fields, W.C. |
| Garston Electric Lighting Order. The Urban District of Garston. | The Urban District Council. | Messrs. Sharpe & Co., 9, Bridge Street, Westminster, S.W. |
| Hoylake and West Kirby Electric Lighting Order. The Urban District of Hoylake and West Kirby. | The Urban District Council. | Do. |
| Ipswich Corporation Electric Lighting Order. The Borough of Ipswich. | The Corporation. | Do. |
| Kearsley Electric Lighting Order. The Urban District of Kearsley. | The Urban District Council. | J. C. Ball, Esq., 16, Parliament Street, S.W. |
| Leatherhead Electric Lighting Order. The Urban District of Leatherhead. | Leatherhead Electric Lighting and Power Company, Limited. | J. L. Higgs, Esq., 3, Delahay Street, Westminster, S.W. |
| Leith Corporation Electric Lighting Order. The Burgh of Leith. | The Corporation. | John Kennedy, Esq., 25, Abingdon Street, Westminster, S.W. |
| Levenshulme Electric Lighting Order. The Urban District of Levenshulme. | The Urban District Council. | Messrs. Dyson and Co., 24, Parliament Street, S.W. |
| Lincoln Electric Lighting Order. The County of the City of Lincoln. | The Corporation. | Messrs. Tahourdin and Hitchcock, 20, Victoria Street, S.W. |
| Llandrindod Wells Electric Lighting Order. The Urban District of Llandrindod Wells. | Llandrindod Wells Electric Light Power Company, Limited. | Messrs. Sherwood and Co., 7, Great George Street, Westminster, S.W. |
| THE COUNTY OF LONDON: | | |
| Blackheath and Greenwich District Electric Lighting Order. The Parish of Greenwich and portions of the Parishes of Charlton, Eltham, Kidbrook, Lee, and Lewisham. | Blackheath and Greenwich District Electric Light Company, Limited. | George Whale, Esq., 107, Cannon Street, E.C. |
| County of London (East) Electric Lighting Order. The Parishes of St. George-in-the-East, and St. Matthew, Bethnal Green, the Hamlet of Mile End Old Town, and the Districts of Limehouse and Poplar. | County of London and Brush Provincial Electric Lighting Company, Limited. | S. Morse, Esq., 4, Fenchurch Avenue, E.C. |
| County of London (Northern Extensions) Electric Lighting Order. Portion of the District of the Holborn District Board of Works, the Liberty of the Charterhouse, and portions of the Parish of St. Leonard, Shoreditch. | County of London and Brush Provincial Electric Lighting Company, Limited. | Do. |
| Fulham Electric Lighting Order. The Parish of Fulham. | The Vestry. | T. Blanco White, Esq., 59 and 60, Chancery Lane, W.C. |
| London Electric Supply Corporation Electric Lighting (Westminster) Order. Portion of the United Parishes of St. Margaret and St. John the Evangelist, Westminster. | London Electric Supply Corporation, Limited. | Messrs. Deabon and Co., 9, Great St. Helen's, E.C. |
| Newington Electric Lighting Order. The Parish of St. Mary, Newington. | The Vestry. | L. J. Dunham, Esq., Vestry Hall, Walworth Road, S.E. |
| Morecambe Electric Lighting Order. The Urban District of Morecambe. | The Urban District Council. | Messrs. Hargreaves and Co., 18, Abingdon Street, Westminster, S.W. |
| Morley Corporation Electric Lighting Order. The Borough of Morley. | The Corporation. | Messrs. Sharpe and Co., 9, Bridge Street, Westminster, S.W. |
| Moss Side Electric Lighting Order. The Urban District of Moss Side. | The Urban District Council. | Messrs. Dyson and Co., 24, Parliament Street, S.W. |
| Newmarket Electric Lighting Order. The Urban District of Newmarket. | The Urban District Council. | Do. |
| Northwich and District Electric Lighting Order. The Township of Northwich and portion of the Rural District of Northwich. | Northwich Electric Supply Company, Limited. | Messrs. Taylor, Hoare and Pilcher, 12, Norfolk Street, Strand, W.C. |
| Poole and Branksome Electric Lighting Order. The Municipal Borough of Poole and the Urban District of Branksome. | Bournemouth and District Electric Supply Company, Limited. | S. Morse Esq., 4, Fenchurch Avenue, E.C. |
| Prescot District Electric Lighting Order. The Urban District of Huyton-with-Roby and the Parishes of Rainhill, Whiston, Knowsley, and Eccleston, in the Whiston Rural District. | British Insulated Wire Company, Limited. | Do. |
| Ramsbottom Electric Lighting Order. The Urban District of Ramsbottom. | The Urban District Council. | Messrs. Baker & Co., 22, Great George Street, Westminster, S.W. |

| Title of order and description of area. | Name of promoters. | Agents. |
|---|---|---|
| Redditch Electric Lighting Order. The Urban District of Redditch. | The Urban District Council. | Messrs. Ashwell, Browning & Tutin, 30, Ely Place, E.C. |
| Reigate Corporation Electric Lighting Order. The Borough of Reigate. | The Corporation. | Messrs. Sherwood and Co., 7, Great George Street, Westminster, S.W. |
| Rottingdean and District Electric Lighting Order. The Parishes of Rottingdean and Ovingdean and the Village of Woodendean, within the Rural District of Newhaven. | Rottingdean Electric Lighting and Power Company, Limited. | J. L. Higgs, Esq., 3, Delahay Street, Westminster, S.W. |
| Southampton Electric Lighting Order. Portion of the County Borough of Southampton. | The Corporation. | Messrs. Robbins, Billing & Co., Surrey House, Victoria Embankment, W.C. |
| Stretford Electric Lighting Order. The Urban District of Stretford. | The Urban District Council. | Messrs. Dyson and Co., 24, Parliament Street, S.W. |
| Swadlincote Electric Lighting Order. The Urban District of Swadlincote. | The Urban District Council. | Messrs. Baker & Co., 22, Great George Street, Westminster, S.W. |
| Tonbridge Electric Lighting Order. The Urban District of Tonbridge. | The Urban District Council. | Messrs. Keeping and Gloag, 2, Dean's Yard, Westminster, S.W. |
| Ventnor Electric Lighting Order. The Urban District of Ventnor. | The Urban District Council. | Messrs. Clarkson and Toovey, 98, Great Tower Street, E.C. |
| Wallasey Electric Lighting Order. The Urban District of Wallasey. | The Urban District Council. | Messrs. Sharpe and Co., 9, Bridge Street, Westminster, S.W. |
| Walton-on-Thames Electric Lighting Order. The Urban District of Walton-on-Thames. | Walton-on-Thames Electric Lighting and Power Company, Limited. | J. L. Higgs, Esq., 3, Delahay Street, Westminster, S.W. |
| Watford Electric Lighting Order. The Urban District of Watford. | The Urban District Council. | Messrs. Baker & Co., 22, Great George Street, Westminster, S.W. |
| Wilmslow Electric Lighting Order. The Urban District of Wilmslow. | The Urban District Council. | Messrs. Sharpe and Co., 9, Bridge Street, Westminster, S.W. |
| Wimbledon Electric Lighting Order. The Urban District of Wimbledon. | The Urban District Council. | W. H. Whitfield, Esq., 22, Surrey Street, Strand, W.C. |
| Withington District Electric Lighting Order. The Urban District of Withington. | The Urban District Council. | Messrs. Dyson and Co., 24, Parliament Street, S.W. |
| Wrexham Corporation Electric Lighting Order. The Borough of Wrexham. | The Corporation. | Messrs. Sharpe and Co., 9, Bridge Street, Westminster, S.W. |

## LORD KELVIN ON ELECTRIFICATION OF AIR.

AT a meeting of the Royal Society of Edinburgh, on 21st December, the President (Lord Kelvin) made a communication on "The Electrification of Air by Röntgen Rays," the outcome, as he explained, of experiments which had occupied his attention, along with that of Dr. Beattie and Dr. Smolan, since the end of October last. The primary object of their investigations, he said, was to test the effect of the Röntgen rays shed upon electrified air—to see whether or not the Röntgen rays had any electrifying effect on air. The following arrangement was made:—A lead cylinder, 76 centimetres long and 23 centimetres in diameter, was constructed. Both ends were closed with paraffined cardboard, which was transparent to the rays. At the end distant from the electrometer the Röntgen lamp (a vacuum vessel with an oblique platinum plate) was placed. In the other end two holes were made, one in the middle of which a glass tube of sufficient length was placed to allow the end in the lead cylinder to be put into any desired place in the cylinder. By means of this air was drawn through an electric filter by an air pump. The other hole, a little from the centre, contained a second glass tube by which air was drawn through Indiarubber tubing from the quadrangle of the University of Glasgow outside the laboratory. In one series of experiments the end of the suction pipe was kept in the centre of the lead cylinder, and at various points 10 centimetres apart, beginning with a point close to the end distant from the Röntgen lamp. In every case the air pumped through the filter was found to be negatively electrified when no screen, or an aluminium screen to the Röntgen lamp, was used, and either not electrified at all or only slightly negatively when a lead screen was used. When the Röntgen lamp was removed or stopped, and air pumped through the filter, no deflection was observed on the electrometer. This showed that the air of the quadrangle was not electrified sufficiently to show any deflection when tested by filter and electrometer. Similar results were obtained with the end of the suction pipe placed so as to touch the floor of the lead cylinder, the roof, or the sides. Whether or not the air was pumped away from a place in the cylinder illuminated by the Röntgen rays, it was in all cases found to be negatively electrified. In the earlier experiments, the air drawn through the filter was replaced by air coming in from the laboratory at the open end. They found evidence of disturbance, due to electrification of the air of the laboratory by brush discharges from electrodes between the induction coil and the Röntgen lamp, and from spark in induction coil. These sources of disturbance were eliminated by arrangement of the lead cylinder already described. They also found a very decided electrification of air—sometimes negative, sometimes positive—when the Röntgen rays were shone across a glass tube or an aluminium tube, and the air pumped through from the quadrangle to the filter. A primary object of their experiments was to test whether air electrified positively or negatively lost its charge by the passage of Röntgen rays through it. They soon obtained an affirmative answer to that question. They found that positively electrified air lost its positive electricity, and in some cases acquired negative electricity under the influence of Röntgen rays, and they were thus led to investigate the effect of Röntgen rays, to begin with, on air unelectrified. In carrying out the experiments, his lordship added, they found it absolutely necessary not only to surround the electrometer with wire gauze in the usual manner, but they had also to place it on a sheet of lead, and to surround the side facing the Röntgen lamp with lead too. In some cases it was even necessary to cover up the whole with paper to prevent the electrified air of the room from disturbing the instrument.

On the motion of Lord McLaren, who offered some complimentary remarks on the subject—making special mention of the diagram which Lord Kelvin so deftly drew on the blackboard in illustration of the apparatus employed in the experiments, Lord Kelvin was awarded a hearty vote of thanks.

## CORRESPONDENCE.

### The Possibilities of Primary Batteries for Motor Purposes.

Though the subsequent remarks were suggested by the recent article on "McDonald's Battery and its Tests," which appeared in the ELECTRICAL REVIEW, yet they are not intended in any sense as a reply to any statements contained in that article. For, although one may not agree altogether with every statement made therein, it may readily be admitted that the article constitutes a very fair piece of criticism. It is only necessary to refer specially to the point regarding which information is requested—the difference between the statements obtained in my letter to Mr. Urquhart, and the statements contained in the report. The explanation suggested in the article is based on the assumption that the data refer to *two* successive tests of the same cell. They both really referred to the *same* test. Those given in the letter were not intended for publication. I told Mr. Urquhart that all statements made at that time were subject to correction, as I had not then tested the accuracy of the galvanometer which I was using. I did not repeat that caution in the letter as I did not expect it to be published. The galvanometer was subsequently found to give readings about one-tenth too high, and the correct values of the data were given in the report.

Neither are the remarks here made intended as a defence of the McDonald cell. I have absolutely no interest in it beyond a purely scientific interest; and, as the above heading indicates, the remarks are offered merely as a contribution on an interesting point in practical science.

If a current of strength, $c$, flows through a battery and a motor which is working at efficiency, $\varepsilon$, we have

$$c = c_0 (1 - \varepsilon), \qquad (1)$$

where $c_0$ is the initial value of the current before the armature begins to revolve. And the value of the electrical work which is transformed per second in the motor exclusive of heat developed in the armature is

$$H = \varepsilon n e c \qquad (2)$$

where $e$ is the electromotive force of each cell, and $n$ is the number of cells in series. These equations give

$$H = n e c_0 \varepsilon (1 - \varepsilon) \qquad (3)$$

This is a maximum when $\varepsilon = \frac{1}{2}$. In that case H becomes

$$H' = \tfrac{1}{4} n e c_0.$$

To get a definite example, take the case of the McDonald

cell, put $e = 1$ volt, $c_0 = 13$ amperes, and let H′ be 1 horse-power. This gives $n = 230$. If the weight of each cell is 8·5 lbs., the total weight of the battery is 1,955 lbs. (The weight of the cell in question is given as 8 lbs., but I take 8·5 for a reason which will appear subsequently.)

Similarly, to get a definite example, sufficient for purposes of comparison, in the case of an accumulator, take the Faure-King autocar accumulator, referred to in the issue of this journal for Nov. 27th, p. 695. If the maximum discharge of 53 amperes is taken at half efficiency, and the voltage is 2, the number of cells required is 14, the total weight being 854 lbs.

The life of the accumulator is 5 hours at the maximum safe rate of discharge. But, if we suppose that the motor works at 80 per cent. efficiency on the average, the average current is about half the maximum, and the life might be (say) 8 hours. In the case of the McDonald cell the average current is, under that condition, 4·3 amperes, so that the voltage would not change much in 6 hours; and a few ounces of the proper chemicals originally placed in excess in each cell would keep the voltage constant for 10 or 12 hours, or more, while only about one ounce of zinc would be used in each cell during that time. It is the fact expressed in equation (1) that the current at usual efficiencies is much less than the maximum current, which constitutes at once the weakness and the strength of the primary battery for motor purposes. It makes it necessary to employ a large number of cells, which means great weight; but, on the other hand, it gives a long working period. In this respect, in the above examples, the accumulators could only compete with the primary cells if two sets were carried, when there would be little to choose between the batteries in regard to weight. In the example of accumulator work given, the assumption made, limits the motor to work on comparatively low gradients, unless the maximum safe current be exceeded. To get an arrangement of the accumulators which will give the discharge of 53 amperes when ascending a gradient which forces the motor to work at 20 per cent. efficiency, and which gives H = one-horse power at half efficiency, we must have 23 cells, the total weight being 1,403 lbs. instead of 1,955 in the case of the primary cells. Therefore the accumulator propelled car would ascend a steeper gradient at a given efficiency than a similar car propelled by the primary cells could ascend at the same efficiency. But, still more than in the former case, would it have far less lasting power. In the same way any practical example may be worked out when the data are given, the quantity H being supposed to include all losses.

The conclusion is that, in cases where a supply of electricity for accumulators can be readily had, primary batteries cannot compete with secondary batteries in respect of lightness and in respect of cheapness of fuel. On the other hand, because of the bad effects of vibration, the cost in the long run might be smaller when primary cells are employed. And again, in respect of lasting power, a battery of primary cells can have a marked advantage.

The introduction of an otherwise good primary cell, working at about 2 volts, or of a cell having half the internal resistance of a McDonald cell of the same weight, would give the primary battery a complete advantage on almost all points.

But, in any case, the primary battery could only be employed where luxury, not economy, was the aim.

**W. Peddie.**

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### A Critic Criticised.

The "Independent Engineer," whose opinions we published a fortnight ago, closes this matter so far as he is concerned, in the following remarks:—

"Your publication the other week of my expressions of opinion with reference to the above has made me, unwillingly or not, transgress somewhat the unwritten law of professional etiquette, so that I may as well now be hung for a sheep as a lamb, and take more notice than I otherwise should of Mr. Parshall's reply in your last issue, even though this reply is really unimportant enough to leave alone.

"I leave the Electrical Review itself to deal with Mr. Parshall's first comment, to the effect that your paper is unfortunate in inserting my remarks, *because* they, to some extent, controverted his statements. Evidently you would have been highly favoured if I had corroborated them throughout. In no respect whatever did I wish or intend to twist or pervert his statements, nor did I succeed in doing so. Above all things, I don't pose as an advocate of Mr. Preece, any more than an opponent of Mr. Parshall, except in so far as either of these gentlemen should respectively follow or transgress the narrow path of public benefit. Government engineers are a nuisance anyway, outside of their own department, only to be surpassed indeed by the practising professor.

"There is really not much to notice in Mr. Parshall's letter. Accumulators apparently he thinks are good enough for a small amount of lighting, not for a large quantity. I don't mind so long as he admits the principle. Development quantitatively will follow in due course. No one would suggest a supply from the trolley bus bar for lighting.

"I note that Mr. Parshall now admits that 5 per cent. of the cars are laid up on the average. This may be the case in the States, where they are prone to run anything on wheels, so long as the latter will go round; but we take more precaution over here, and Mr. Parshall will find 10 per cent. a small average allowance even for horse cars, and with mechanical traction there is much more likelihood of cars being laid up. Even with a 5 per cent. allowance, however, Mr. Parshall's estimate of total units per annum undergoes considerable modification. I don't justify in the least Mr. Preece's assumption of 300 working days in the year; though probably he never intended to give this meaning to his words. The result, however, in units is the same, whether 150 cars run 300 days in the year, or (other things being equal) 120 cars or so run 365 days. Mr. Preece ought, of course, to have made the allowance in cars, not days; but the resultant car mileage is the same. Mr. Parshall is welcome to all the night hours he can get for repairs, &c. From midnight to 6 or 7 a.m. doesn't mean much, if any more, in my experience, than 1 to 4 or 5 a.m. A good deal depends on the foreman or management; any way, night work is good enough for rough cleaning, but not for fine work, or the more elaborate sort of repair. Cars cannot be repainted at night.

"Mr. Preece's item of '70 miles per day per car' is presumably based on particulars derived from the local tramway company; at any rate, it ought to be. If not, then his estimate is wrong in that proportion; 100 miles per day is certainly not too much for any average electric line. Therefore Mr. Preece's report is open to amendment in this respect, just as is Mr. Parshall's! I want to show that I *am* an 'independent engineer.' As I neither seek nor require a professional advertisement, I shall, however, continue to be known by that name; and, moreover, since it seems hardly the proper thing to discuss these matters in public, I don't propose to say more on the question.

**"An Independent Engineer."**

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### British Motor Syndicate.

In a letter on the subject of the patents owned by the British Motor Syndicate, published in your current issue, Mr. Walter Rowbotham writes:—"Now, it is possible to vapourise them" (heavy hydro-carbons) "by a body in the cylinder heated by means of electricity, and thus the danger of fire or of flame blowing out is obviated, and the engine is ready for starting in a few seconds. I ask you if you do not consider this a master patent, and if you do not think there is as much distinction between this method of vapourising and that of using an outside flame, as between the Otto and the other makes of gas engine?"

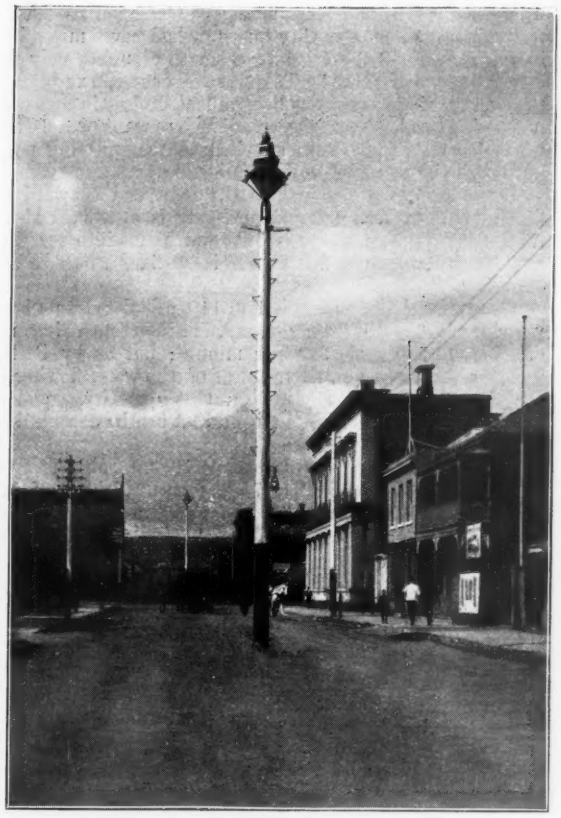
Mr. Rowbotham does not state to what particular patent he refers, but it is certain that the British Motor Syndicate owns no master patent for the method of vapourising hydro-carbons which he describes. The method of vapourising heavy hydro-carbons by means of an electric heating resistance, so that the resulting vapour may be ignited and burned, was published in several technical journals about 10 or 11 years ago (I have not my references by me as I write, and so cannot give exact dates), and was patented about 11 or 12 years ago. It does not follow, however, because the Syndicate referred to does not own a master patent for this method, that it does not own valuable subsidiary patents. That may, or may not, be the case.

**J. G. Lorrain.**

(*Correspondence continued on page* 19.)

## THE LIGHTING OF LAUNCESTON, TASMANIA.

After the slight monotony of home-grown central stations, one turns with keen interest to the scheme of lighting Launceston, Tasmania, which has recently been successfully



Arc Lamps in a Launceston Street.

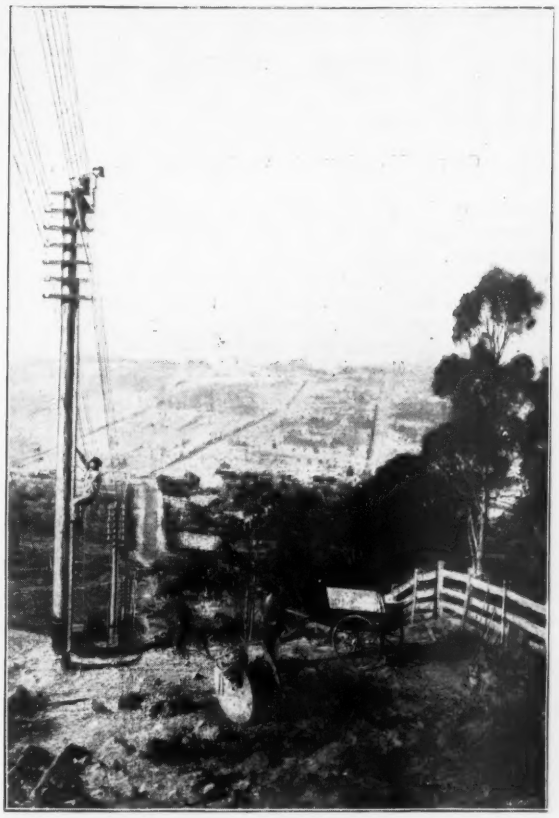
carried out by Messrs. Siemens Bros., Limited. Perhaps the most interesting feature of the work was the way the difficulties were overcome. The site fixed for the generating station is three miles from the centre of Launceston, but there is no road to the place. The building material was prepared at one side of the river and slung across on a wire rope tramway; the machinery, however, had to be taken round a distance of seven miles through the bush, but that only brought it to the top of a steep hill, about 500 feet in height, down which the whole of the plant had to be lowered. How this was accomplished will be seen from the following account. It might be mentioned here that Mr. L. H. Stotherd, of Messrs. Siemens Bros. went out with the plant and superintended the whole of the construction work.

Ever since Launceston was first settled, the residents recognised that great power was available from the South Esk River, which rushes in a series of cataracts for miles above the gorge, where it joins its waters with those of the North Esk, to form the River Tamar. Driving machinery for flour mill purposes was the only application of the enormous force offering itself until comparatively late years, when enterprising citizens, hearing of what was being done in other countries, began to talk of using the water power for the generation of electricity. Various other schemes were mentioned and discussed, and at last the Council decided to get the advice of a hydraulic engineer as to the best place to look for the water power. Mr. George Gordon, M.Inst.C.E., a recognised expert, practising his profession in Victoria, was asked to report upon the question, and did so in April, 1889. This report was so satisfactory, that the Council decided to go on with the work, and by advertisement, invited offers from firms willing to undertake it. From July, 1889, until the latter part of 1890, various offers were made to the Council, one from Messrs. W. Law & Co., another from Ganz & Co., a third from Messrs. Harrison & Whiffen on behalf of the Crompton Electric Supply Company, who submitted a detailed estimate based upon the generating station being at Picnic Rock. None of the offers submitted were deemed satisfactory, and the then city surveyor, the late Mr. Fitzherbert, was instructed to make surveys of the South Esk, and submit results. This he did, and in November, 1890, reported upon three alternative schemes.

June, 1891, was the date of the next move. On the 26th of that month the Town Clerk wrote to Mr. K. L. Murray, M.Inst.E.E., then in the Victorian Government Service, forwarding reports to date, asking his views with reference to the Water Works Committee's latest report, and whether he would undertake to prepare a scheme upon which definite action could be taken. Mr. Murray intimated his willingness to advise the Council, and went to Launceston, where he obtained all the data procurable, and in November, 1891, submitted a report upon the whole question, estimating the cost of the water scheme at about £11,000, buildings £2,000, and the electrical plant £29,000. This estimate was based upon the generating station being fixed at first basin, and the water brought from a point 55 chains up the river, where the intake would be situated. Mr. Murray's report included a scheme for electric trams, with estimate of cost, amounting to £35,200, for three miles of double and three of single track, fully equipped with rolling stock, motors, generators, leads, and all necessaries.

In March, 1892, Mr. C. St. John David, M.S.E., was appointed City Surveyor, succeeding Mr. Fitzherbert, who died some months previously. The electric lighting scheme was submitted to Mr. David, and he set to work on the permanent surveys.

A poll of the citizens of Launceston, as required by law, was taken, and a majority of over two-thirds voted in favour



On the Main Line Coming into Launceston.

of the electric lighting scheme, which the Council therefore decided to go on with. Meantime Mr. David had been investigating with the view of ascertaining the possibility of substituting for the iron water pipes a tunnel, tapping the river at the same point as projected in one of the other schemes, and

driving through a bend to a spot some 90 chains above first basin, which would give him sufficient fall. He found the plan quite practicable, and that it would be far superior to the pipe-track scheme, inasmuch as the tunnel, once made, would entail practically no maintenance cost, and would be free from the objection which

On the Main Line Above Generating Station.

those acquainted with the banks of the South Esk at the point concerned know to be a serious one; that interruptions, vexatious while they last and costly to set right, would be caused by rocks and trees falling on to the pipes. The cost of this scheme, including the necessary dams and other extraneous works, was estimated at £13,169, and after Mr. Murray's cordial approval had been obtained, it was adopted by the Council, and Mr. David was instructed to go on with the work. The dams and race were put in, under Mr. David's personal superintendence, by day labour, at a cost of £1,312; and in July, 1893, the tender of Messrs. O'Neill Bros. & Rodgers, of Sydney, was accepted for construction of the tunnel. It was freely asserted that the tunnel could not be driven for double the estimated cost; that it would occupy three years in driving, &c., objectors basing their arguments upon the cost of driving in similar country elsewhere. Events proved the unreliability of the objectors' data, as the drive was put through in 16 months' actual working time, driving from both ends; and when on March 28th, 1895, the men working from the two ends met, the engineer had the satisfaction of finding that his levels had been less than an inch out. The actual cost of the tunnel proved to be £11,913, or with dams, &c., a total of £13,225, as against £13,169 estimated.

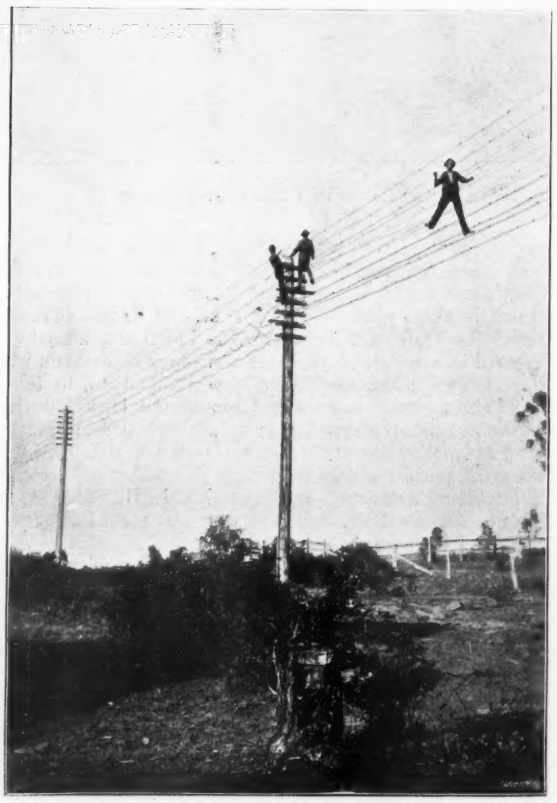
The use of compressed air to operate the drills in the drives was a surprise to many, who anticipated that, owing to the length of the supply pipes, difficulty would be experienced in obtaining a sufficiency of air unless excessively large pipes were used. The engine and compressor were situated over the centre of the tunnel on the crown of the hill, at an altitude of 260 feet above the inlet, the air having therefore to be ultimately conveyed not less than 3,000 feet on each side; 2½-inch wrought-iron pipes were used to the mouth of each heading, then 1½-inch pipes along to the face, where the customary 1-inch flexible hose was used. Not only was no difficulty experienced in providing plenty of air to the machines, but in trimming up after the drives had met, air was carried right through the tunnel, a distance of not less than 4,300 feet. The self-contained direct-acting compressor engine and boiler were built by Mr. W. H. Knight, of Launceston, and gave every satisfaction to the contractors. The invert of the tunnel was lined in semi-circular section to 2 feet 6 inches radius in cement concrete; the roof was very solid, requiring but little support, about 200 feet in all being entirely lined. The hardness and toughness of the rocks were such as the City Surveyor had never met with; in one week of 18 8-hour shifts a length of 9 feet only was driven in one heading! This was, of course, exceptional, the average weekly progress being about 20 feet in each face. At the inlet end the hauling was done by means of a 6-H.P. vertical engine, which also supplied the compressing plant with water by means of a Westinghouse pump.

Coarse screens are placed at the inlet end to ward off floating timber, &c., and a sluice gate is also fixed there. At the outlet end of the tunnel the water runs into a screening chamber, where a fine screen is so fixed as to be self cleansing.

The grade of the tunnel is 1 in 110, calculated to give a velocity of about 10 feet per second, and therefore a discharge of about 11,780 cubic feet per minute; but as by Parliamentary restrictions only two-thirds of the water flowing in the river is to be made use of, that quantity, equal to 10,000 cubic feet per minute, is all that can be depended on during dry summer weather.

The resulting horse-power, taking 10,000 cubic feet per minute as a basis, is 1,562, at 75 per cent. efficiency of turbine, and costs therefore £8 10s. per horse-power, a rate which compares very favourably with similar work in any part of the world.

The velocity of the water may appear high, but was not decided upon without mature consideration. The declivity



Straining up Wires on Main Line.

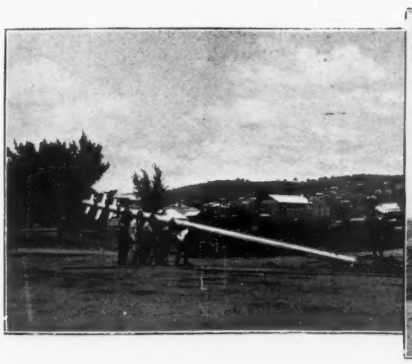
of the river bank is such, that a few feet in length of tunnel which might have been gained by adopting a flatter grade, would have been inappreciable, while the extra cost entailed by increased dimensions of tunnel would have been considerable. The nature of the surrounding rock and of the con-

crete invert, made it possible to give even a greater velocity without injury, so the size of the drive was fixed at the smallest dimensions which would allow of fair work being done at the face. This was 5 feet 6 inches diameter, and the grade of 1 in 110 was therefore necessary to carry the required quantity of water. It may be mentioned, as bearing out the hypothesis of the city engineer with regard to erosion, that after the water had been flowing for 6 months, he carefully examined the tunnel, invert, &c., and found no signs of injury whatever.

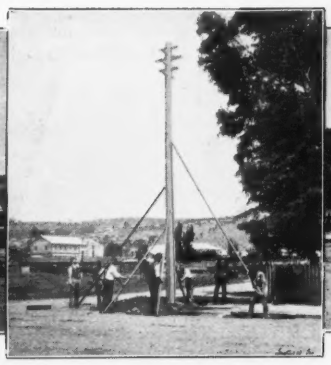
The bywash rises to a height of 3 feet above the crown of the tunnel, and thus by filling the tunnel for a length of 330 feet, a water cushion is formed, which checks the velocity of the flow, and assists very largely in depositing sand, grit, &c., and this material is still further intercepted by a catch pit at the tunnel mouth, whence it is cleared by a 12-inch pipe.

From the screening chamber the water, after straining, flows through a wrought-iron sluice gate opening, and by a pipe line is conveyed to the power station. The pipe is of wrought-iron, with flanged joints, is $\frac{1}{4}$-inch thick, and for the first 82 feet is 5 feet in diameter, the remaining 121 feet being 4 feet in diameter. The lower end is expanded into a bell mouth, 6 feet by 2 feet 6 inches.

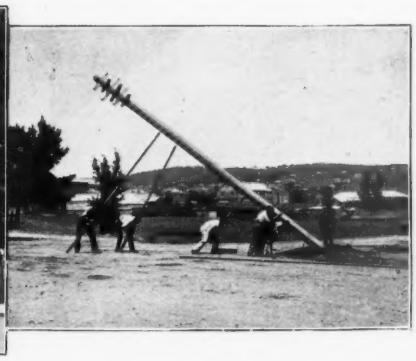
Placing Pole in Position for Erection.



Pole Erection—First Lift.

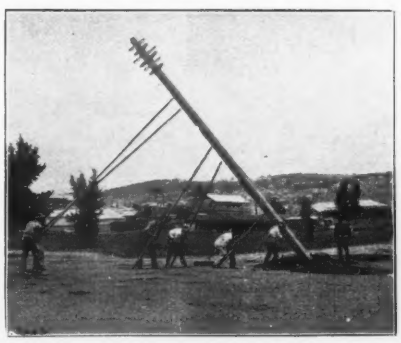


Preparing to Fill.



Second Lift.

Getting the great pipes into position was a work of no little difficulty. The illustrations give some idea of what the hillside down which they had to be lowered is like, but no one who has not visited the place can appreciate the danger and difficulty which were met by those who lowered these 75 tons of pipes of the sizes named down a hill rough with rocks and tree stumps at grades ranging from 1 in 10 to 1 in $1\frac{1}{2}$. As fixed, they lie on grades of 1 in 90, 1 in 2, and 1 in 1·2. They rest on cast-iron saddles, which are firmly supported by and fixed to concrete piers. Half-inch wrought-iron saddle plates are riveted to the under side of the pipes, and are provided with a lip on the upper end, which catches on the saddles and so prevents slip. As additional precaution, and so that there will be no danger of them slipping when their weight is added to by the passage of water passing through them, $1\frac{1}{2}$-inch anchor bars with coupling screws are strapped to the pipe, and held back to the solid rock by means of $1\frac{3}{4}$-inch dowels. The bell mouth before mentioned conveys the water to a wrought-iron receiver 88 feet long, which extends along the back of the power house, and is supported in similar manner to the pipes. The central portion, 41 feet in length, is 6 feet in diameter, and is of wrought-iron $\frac{3}{8}$-inch thick; the two end portions being 3 feet in diameter and $\frac{1}{4}$-inch thick, all being held back by $1\frac{1}{2}$-inch anchor bars as before described. The receiver is fitted with four 4-inch dead weight safety valves.



Third Lift.

From the 6-feet section the water is led into the building by means of four 2 feet 4-inch pipes, and from the 3-feet sections by six 12-inch pipes, though only three of the former and five of the latter are at present in use, one of each being left for future extensions. The water from these pipes is taken directly to the turbines, draft tubes being made use of to ensure at least 110 feet of working head.

The generating station is situated above highest known flood mark on the river bank. It is built of the local basalt on concrete foundations, and with galvanised iron roof; is 105 feet by 24 feet in the clear, with a central bay of 40 feet, which is six feet wider. The height of the wings is 15 feet, and of the centre 22 feet; to the wall plate in each case. The tail race extends nearly the entire length of the building, is 9 feet wide and 12 feet deep, and was excavated in the solid basalt. It is arched over with concrete, on which are bedded the girders to which the turbines and other machinery are bolted. The building was constructed by Mr. J. T. Farmilo, of Launceston, whose contract, which included all foundations, amounted to £1,838. Carrying the building materials from Launceston to such an inaccessible site was no easy matter. The contractor had to make a practicable road over very rough country, and conveyed the whole of the materials for building and a part of the ironwork for pipes across the river on a rope tramway, the span of which was about 350 feet. The whole of the works connected with the tunnel, the iron pipes and buildings, were carried out to the designs and under the supervision of Mr. C. St. John David, M.S.E., City Engineer.

It was on December 21st, 1892, that Mr. K. L. Murray, as consulting engineer to the Council, was requested to prepare plans, specifications, &c., for the supply, erection, and working for six months, of all the necessary machinery for carrying out the electric light scheme. He did so, submitted them to the Council, who, after several personal consultations with Mr. Murray, gave instructions that tenders should be invited upon the specifications, conditions of contract, &c., adopted.

It may be mentioned that, with his specifications, Mr. Murray submitted two sets of conditions of contract; one identical with those under which Victorian Government contracts are carried out, and which gave the superintending officer absolute control over the work, allowing practically no appeal from his decision; the other having clauses which

On the Main Line—Wires Coming Down Towards the River.

allowed the parties to the contract to appeal to arbitrators in cases of disagreement. The Council, after considering the question, adopted the former, which are similar to the conditions under which Launceston city public works have been carried out for years.

Tenders were invited accordingly in the Australian Colonies, England and America, and resulted in the receipt of four, viz., one each from the W. T. Henley Telegraph Company, Siemens Bros. & Co., the Brush Electric Engineering Company, and the Electric Construction Company. These firms offered as under:—

| Tenderer. | Machinery, &c. | Labour, fitting. | Maintenance 6 months. | Total. |
|---|---|---|---|---|
| | £ s. d. | £ s. d. | £ s. d. | £ s. d. |
| Siemens Bros. and Co. ... | 24,721 15 0 | 5,400 0 0 | 1,900 0 0 | 32,021 15 0 |
| W. T. Henley's Company ... | 25.588 18 4 | 1,526 13 7 | 1,500 0 0 | 28,615 11 11 |
| Brush E. E. Company ... ... | 25,738 11 1 | 5,284 9 10 | 1,050 0 0 | 32,073 0 11 |
| Electric Construction Company | ... | ... | ... | 38,335 0 0 |

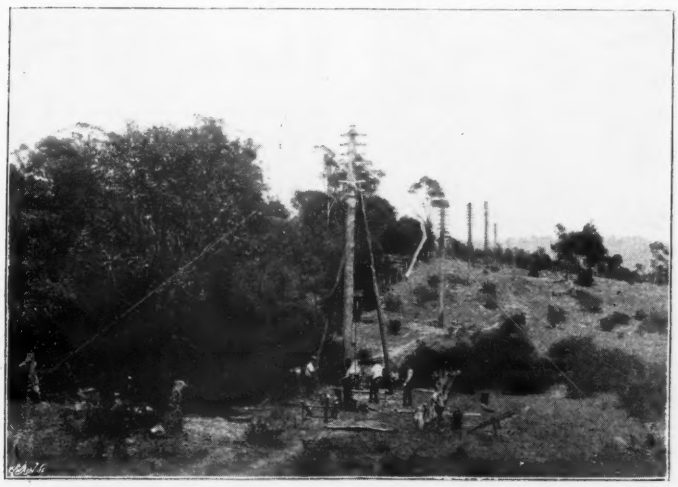
Mr. Murray analysed the two tenders, and recommended that of Siemens Brothers. The tender of Messrs. Siemens Brothers was accepted, and the contract signed in March, 1894, by the Mayor, Mr. Alderman Price, who had all through the discussion consistently supported Mr. Murray's recommendation.

The contractors soon got to work, took extensive premises on the wharf, entered into a contract for supply of the saplings for poles, and arranged with Mr. Dunk, of Sydney, owner of a patent pole-trimming machine, to bring one of his machines to Launceston, and trim all the poles to the form decided upon by the superintending engineer. The specification contemplated trimming the poles by manual labour, but the contractors were desirous to make them look well, and as only by the use of the machine could they be given that smooth and finished appearance which has been so admired in Launceston, the extra expense was not minded, and soon the contractors' yard became a busy scene, with poles in the rough at one end, finished poles at the other, and between them the lathe-like machine turning and cutting the huge logs to pattern; heaps of cuttings and shavings lying around. After being trimmed to shape, octagonal from the ground line to 8 feet above that line, and circular thence to the top with proper taper, the poles were mortised and the arms fitted into them, then a coat of paint given, and they were carted away to the site of their permanent position. Getting them fixed up was by no means an easy task. The main line track from the generating to the distributing station is up and down several steep hills, the road unmade, rough, and rocky. Sinking the holes was a difficulty, too, in many places, and from different causes. There are several hundred fixed in solid rock, where the holes had to be blasted. Then in many places where poles were to stand, gas and water pipes, or sewers, were met with. Then across the river in Inveresk, after breaking through the thin coat of hard surface soil, sludge only was found in which to fix the poles. In these places, two stout pieces of timber, 6 feet long, were bolted to the pole at right angles to each other, one at its foot, and the other 5 feet up. Only by doing this could the needful resistance to strain be given to the pole. In many cases, in other parts of the town, where extra solidity was required, the poles were set in cement concrete. All difficulties were overcome, and street by street, beginning at the outlying parts, the poles were got into position, and fitted with the insulators. The engineer's plan

Erecting Wires on Main Line near Generating Station.

was to distribute the electricity from a station conveniently situated for the purpose in the city, bringing the energy from the generating station by means of insulated cables suspended to poles, in as direct a line as possible. This line was the first work undertaken by the contractors. Substantial towers were constructed at both sides of the river,

between them the leads were carried across the river, and on to the distributing station, a distance of about two miles; there they were connected through lightning arresters, and other apparatus, to the switchboards. From these switchboards the distributing mains pass out and along the streets in all directions over the city, the leads carrying the continuous current to the arc lamps which illuminate the streets, and those carrying the alternating current to transformers, where the current is reduced to the low voltage necessary for use in the incandescent street lamps, as well as those which light up public and private buildings. The superintending engineer originally intended to arrange for working under the transformer sub-station system, that is, to divide the city into sections, and in some fairly central position of each have one or more transformers fixed, to which the high tension mains should be brought by the most direct route. The electricity at the reduced voltage would then be distributed from the transformers over the section. After many attempts to obtain the necessary information (mainly the private lighting likely to be required about the city), resulting in considerable delays to the contractors, as they were unable to get their instructions as to sizes and routes of the leads, Mr. Murray felt obliged to change his plans, and to adopt the distributed transformer system, under which a much larger number of smaller-sized transformers, distributed about all over the city as close to the points where lighting is required as possible, would be used, and upon this system the city has been wired.



Erecting Pole on Main Line.

In due course the machinery arrived in Launceston, and as the Generating Station was not ready for its reception, the contractors, finding it necessary to get the heavy castings from Launceston to where they were to be placed before the winter set in, erected an iron building immediately above the site of the Generating Station, and there the machinery was stored for several months. Meanwhile the question of how it was to be got down the hill engaged the attention of the contractors. From the top to the site of station is about 400 feet (vertically), the grade of the best obtainable route about 1 in 1. Many pieces of the machinery weighed 30 cwt., so that the task of getting all safely to the bottom was no easy one. Finally a strong wooden tramway was laid, and on it a substantial truck, capable of carrying the heaviest piece of machinery, placed. A wire rope was fastened to the truck, and passed round a winch firmly fixed at a sufficient distance from the hill-top, and then it was found that the men could lower down the loaded truck with comparative ease. Of course the process was a slow one, but it was sure, for all was lowered without any serious hitch or interruption, and the machinery placed on its foundations.

Generating Station.

The machinery fitted only takes up about 400 out of the 1,560 H.P. available, the water running through the tunnel supplies; so that water is available without extra cost to drive nearly four times as much machinery as has been arranged for at the start. The water pipes from tunnel and the building are arranged to accommodate about 50 per cent. more effective alternating plant, and 25 per cent. more arc lighting plant, so that additions to the available energy can be obtained at comparatively small cost.

There are eight turbines fixed and at work, all of the Thomson Vortex type, fitted with the Murray hydraulic governor They are adapted for a fall of 110 feet, and arranged for coupling direct to the dynamos. The outer case of these turbines is of cast-iron, and the revolving blades of brass. The fixed guide blades are of Delta metal, and are movable for adapting the entrance orifices to any quantity of water below the full supply. The wheels work vertically, and the draft pipes are fixed so that part of the fall acts by suction. They were made by Messrs. Gilbert Gilkes & Co., of Kendal, England. Five of the turbines drive arc light dynamos at 800 revolutions a minute, at which speed they each give 21 horse-power. The other three drive alternators at 460 revolutions a minute, and each gives 158 horse-power.

The arc light dynamos are of Siemens Bros.' manufacture, and give a constant current of 7 amperes, and an E.M.F. of 1,750 volts when running at 800 revolutions a minute. The armatures are of the ring type and wire wound. The electro-magnets are of the double magnetic circuit type, made of the very best wrought-iron, and are series wound. They are driven direct by the turbines, being connected to the turbine shaft by means of a coupling consisting of two

LARGE TURBINE CASE ARRIVING AT BOTTOM OF HILL.

face plates fastened to the shafts respectively of the turbine and dynamo, and bolted together. The dynamos are fitted with Siemens's patent constant current regulator driven from their spindles, and arranged so as to shift the brushes round the commutator in a direction determined by a small solenoid in series with the lamp circuit. The alternators are of the Siemens's W type, having revolving disc armatures, each of which has 24 coils, and revolves at a speed of 460 revolutions per minute, when the output from the alternator is 100 kilowatts at 2,000 volts E.M.F. The alternators are connected directly to the turbines by means of a flexible coupling, consisting of two face plates fastened to their respective shafts, each plate provided with teeth, arranged by means of springs inserted between the teeth, to engage so that they will drive satisfactorily whatever is the relative position of the two shafts.

Each alternator has an exciter in the form of one of Siemens's H.B. type of continuous current dynamo connected direct to the alternator shaft. The fields of these alternators are strong and the armature reaction weak, which ensures their running in parallel steadily and safely. There are two switchboards in the generating station; one for the arc lighting direct current apparatus, and the other for the alternating work. The bases are of marble, and with their mountings, the switchboards, besides being arranged so as to be most convenient for working, form a very ornamental addition to the equipment of the station.

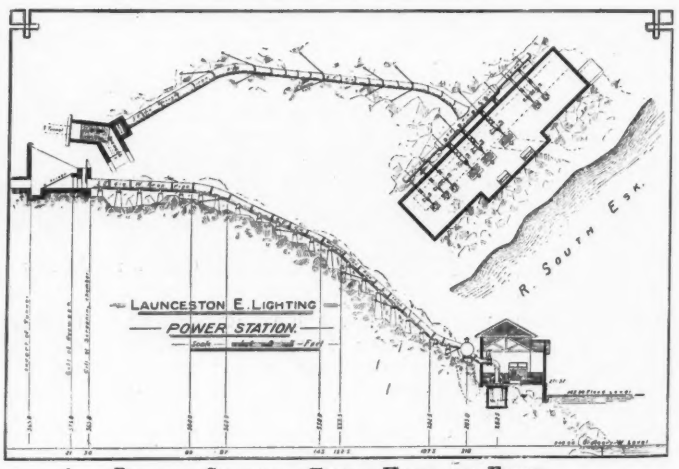
The wiring for the arc lamps being in four separate circuits, the arc lighting switchboard is so arranged that any one of the five arc light dynamos may be connected to any one of the four circuits. It may be mentioned here that the circuits are designed and fixed so that only every alternate lamp is fed from the same dynamo. In the event of a breakdown, therefore, only half the street lamps will be out during the very short time it will take to switch on the spare dynamo.

Two pairs of wires form the mains for the alternating high tension circuits. These are connected together at the incandescent switchboard, and the switching apparatus is so arranged that the alternators can be run in parallel on these mains; no difficulty or trouble whatever has been experienced in working these machines in parallel. At first, one of the alternators supplied requirements. Latterly two have been necessary; at any time the third can be switched on to take the place of either of the two working, or to work with them in parallel. The boards are fitted with all necessary lightning arresters, switches, fuses, ampere and volt meters, and indeed all arrangements necessary for safety, as well as for making the various changes in the different circuits always found desirable for securing regularity and certainty of supply of current to the lamps. Of the five arc sets, four only are worked at a time, the fifth being kept in reserve in case of accident or breakdown to one of those working. Similarly, only two of the three alternator sets are to ordinarily be at work together, though it seems quite likely that a very short time will elapse before more lighting than two alternators can supply will be required in Launceston. The machinery is so substantial, and the risk of a breakdown so small, that doubtless the Council will not hesitate to use the reserve machines if necessary; at any rate for the time required to add another unit to their plant.

The transformers used about the city are of capacities varying from one to eight kilowatts. They are of Siemens's patent double magnetic circuit type, consisting of Siemens's special stamped core plates slipped into a bobbin, on which the two coils are wound. They are arranged to transform from 1,900 to 112 volts at a frequency of 92, and at full load have an efficiency of over 98 per cent. They are enclosed in iron watertight cases.

The arc lamps, of which there are 120 erected in the streets, are of the Siemens's "band" type, take seven amperes of current, and burn for 16 hours without being recarboned. Each lamp is fitted with an automatic cut-out. They are placed inside lanterns fixed on top of poles which

PLAN OF LAUNCESTON—ARC LAMPS SHOWN •



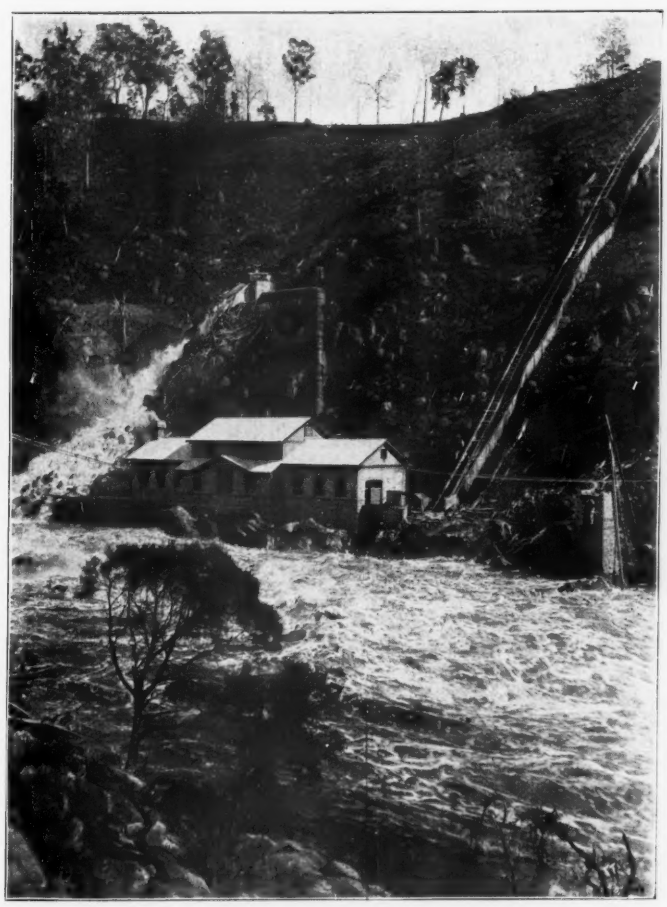

PLAN AND SECTION OF ENGINE HOUSE AND FLUME.

stand in the middle of the streets. The lanterns were made by the contractors to the superintending engineer's design, and are glazed with special dioptrical glass, which, while diffusing the light without any considerable loss, makes the lamps pleasant to look at, being free from that glare so frequently present with arc lamps. The incandescent street lamps, which are nearly all of 50 candle-power, are suspended under iron enamelled reflectors fixed to iron brackets screwed to the poles.

The heavy leads from the generating station, as well as those carrying alternate current about the city, are suspended from steel wire tied to porcelain insulators. The suspending clips, which attach the cables to the steel wire, were specially designed for this work, and made by the contractors in Launceston. The illustrations show the wiring work going on, and the rough nature of the country between the generating station and the city, where the wires carry the whole 400 H.P. of energy now being transmitted to the distributing station.

The distributing station stands on a block of ground at the intersection of Bourke and Canning Streets, shown on the plan of Launceston. It is a neat brick building with central wooden tower, to which the wires are brought, and from which they pass down to the switching apparatus below. The building is divided into a switching and testing room, a workshop, and a store-room. There is also provision for a set of arc lamp regulating stands, fitted with ruby-glass doors. The lightning arresters, switches, and other instruments are fixed on the walls, and arranged so that any of the different sections into which the lighting of the city is divided may be controlled independently of the other sections. Telephone communication has been established between this and the generating station, so that the need of any alteration in the working of the machinery may be made known to the engineer in charge. The telephone line is fixed to the poles which carry all the current between the two stations, and works admirably. It consists of twisted twin wire, specially made by the contractors for this purpose.

VIEW OF GORGE NEAR TO GENERATING STATION.



THE RIVER IN FLOOD.

The difficulty of getting to the generating station from Launceston caused the City Council to instruct their engineer to design a footbridge for placing across the gorge over the river just below the station. This is now being constructed, and when completed will be a light and graceful structure, 184 feet span by 3 feet wide. The cost will be £310.

Owing to causes already mentioned, and with which they had nothing to do, the contractors were prevented from getting the machinery fixed and the electricity distributed within contract time. In consequence of the delays, therefore, it was not until December 10th, 1895, that the energy from the dynamos was turned into the arc lamp circuits, and the citizens of Launceston shown what first class electric lighting means.

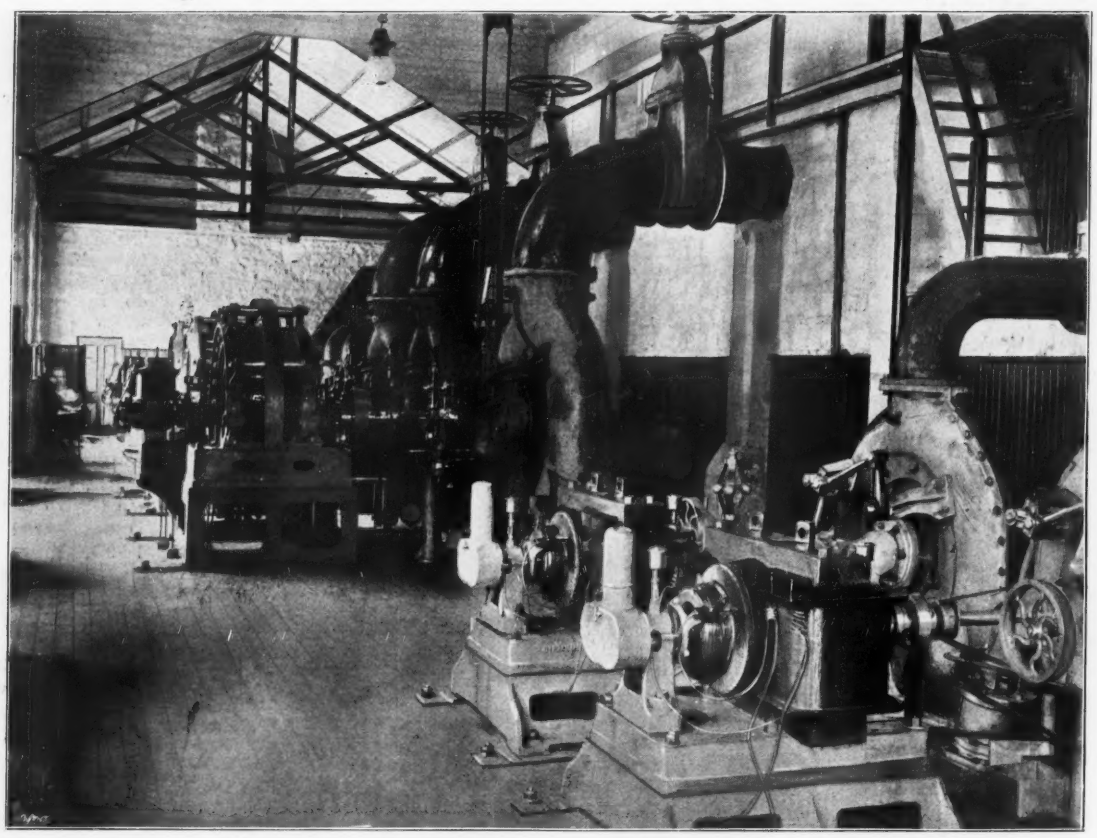
Of the engineers who were engaged on the work, Mr. David is a member of the Society of Engineers of England, and was closely connected with various large engineering works before he left England, in 1880, for Brisbane. In 1892 he accepted the appointment of city engineer at Launceston.

Mr. K. L. Murray, the consulting engineer, is well known in Victoria as an electrical engineer and commissioner of railways. He formed the electrical branch of the Victorian railways, of which he was in charge for nearly 20 years. He arranged and brought into work the block system and the electric

lighting of the Melbourne stations, besides all the many other applications of electricity to railway working in use in Victoria. In 1888, Mr. Murray was entrusted with the lighting of the great Centennial International Exhibition, the biggest are lighting work ever done up to that time under one roof. A paper upon the Exhibition lighting by him was read before the Institution of Electrical Engineers in 1889. Mr. Murray is also a member and Past-President of the Victorian Institute of Engineers, and author of numerous papers upon engineering subjects. In 1892 he was appointed a Commissioner of Victorian Railways, which office he held till April, 1894, when he retired, and has since been privately practising his profession in Melbourne.

## THE SUPPLY OF ELECTRICITY TO SCATTERED DISTRICTS.

THERE can be very little doubt that the problem of supplying electricity to poor and scattered districts is absolutely foreign to what exists in the fairly compact areas met with in towns. Even in a place like London there must be a vast number of non-paying mains, and this must naturally be intensified as electricity supply is extended to the outer regions of the Metropolis. It seems to us, therefore, that when considering a scheme that embraces a poor neighbourhood or a scattered one, so far as probable consumers are concerned, it would be somewhat injudicious to rely on data obtained from populous centres. It would, for instance, be a risky assumption to say that the conditions obtaining even in rich and fairly thickly populated neighbourhoods like Hampstead and Notting Hill were comparable with those of a West End district, or even those of a prosperous provincial town. It is unnecessary to go into a close argument to show that in scattered neighbourhoods the lamp connection per inhabitant is low, and that the costs of production are proportionately high; every electricity supply engineer knows only too well that the figures of actual practice differ materially from those of theory. The recent report presented by Mr. Manville to the Vestry of Newington on the question of lighting the parish by electricity, is more sanguine than we should be. One could scarcely suggest that an engineer of so wide an experience as Mr. Manville would not take account of varying conditions; but if the cost of production in Newington can be kept at Mr. Manville's figure, then the main difficulty of supplying poor and scattered areas, at once disappears. The scheme suggested for Newington comprises plant and mains for providing private consumers with 10,600 lamps of 8 C.P. in the compulsory streets, and for the lighting of the public arc and incandescent lamps. It is proposed to light the streets with 88 arc lamps of 1,200 C.P., and 176 incandescent lamps of 32 C.P., at 2d. per unit. The ability to do street lighting at 2d. per unit depends upon the amount of business done among the private consumers. At Portsmouth, we believe, the cost of street lighting is about 2d. per unit, but the number of private lamps is close upon 30,000. It is assumed that with an output of 372,000 units in Newington, the total cost per unit will be 2·9d. We hope this will be completely realised, but it must be pointed out that at Brighton, with its magnificent output of nearly 900,000 units the cost is 2·36d., Portsmouth, with 406,118 units, is 2·06d., while St. Pancras, with an annual sale of 849,987, costs 3·32d., an increase of ·29d. over the 1894 figures, due probably to extensions into less paying neighbourhoods. It is unnecessary to analyse the various items in the cost per unit. Turning to the revenue side of the account we must confess that the income appears to be higher than what we should have expected from Newington, for after all there cannot be an abundance of well-to-do thoroughfares, nor is it a great place for shops apart from one or two streets. In the first place 20 B.O.T. per lamp per annum is somewhat high, and to assume 6d. per unit all round is not cheap enough at Newington. It is true that at St. Pancras the consumption per lamp is over 20 units, but the revenue per lamp is 8s. 7d., against the expected 10s. at Newington. As a matter of fact, 8s. 6d. is a little higher than the average, and we do not think this is likely to be surpassed at Newington. If the difference of 1s. 6d. per lamp per annum in what Mr. Manville expects and what is realised, it means a lessening in the revenue by nearly £800.



INTERIOR OF LAUNCESTON GENERATING STATION.

## CORRESPONDENCE.

(*Concluded from page* 10.)

### "Communication between Coast and Lightships."

Referring to the leader in your issue of last week, may I ask you, in *fairness* to the "Continuous Cable" system as established at the "Sunk" Lightship, to call attention to the following extract from the Official Report of the Trinity House to the Board of Trade, dated January 1st, 1889 :—

Since the 12th November, 1886, when the last restoration was effected, communication has been maintained with only two interruptions. At 8 a.m. on the 28th December, 1887, the cable was found to have parted. On the following morning, at 9 a.m., it was grappled for and recovered by the crew of the light-vessel, who completed the re-splicing of the cable at 2.10 p.m. on the 31st. Again, at 9 a.m. on the 13th November last, the cable parted, when it was grappled for as before, raised, and buoyed by 2.40 p.m. on the same day, the re-splicing being completed by 2.30 p.m. on the following day. It was unnecessary on either of these occasions for the Corporation to call in any extraneous aid in effecting the restorations.

Your readers will see by the foregoing that during the two years—1887 and 1888—there were only two interruptions, both of a minor character, communication being suspended for less than six days in all.

The 90 days' interruptions referred to in your article took place in 1885-86, when the system was only in its experimental stage, and before the crew of the lightship had obtained sufficient experience in its working.

F. Le-B. B.

[We reply to this letter in a "Note."—EDS. ELEC. REV.]

### The Telegraph and The Berne Convention.

As being a member of the telegraphic profession, my attention was directed to an article which appeared in your last issue (dated 18th) relating to certain proposed "improvements," as I understand, in the Berne Convention. If I may be allowed to encroach upon your valuable space, I should much like to call attention to one or two points which, though no doubt founded upon excellent theory, appear to me in some cases utterly impracticable in actual use, and in others merely revivals of customs long since disused—and disused *because* they were found to be impracticable, and likely to cause errors in transmission.

Your correspondent suggests that a complete set of mathematical symbols should be coded, thereby greatly increasing, he maintains, the number of commercial telegrams at least. Now, in the first place, to take an example from his list, the *charge* for sending the letters A R for the sign of addition (+), would be precisely the same as for the word "plus"; and then, such signs are already provided for in the various commercial code-books, when found necessary. And this applies likewise to the other signs. But A R is always employed to proclaim the *end of transmission*. This signal (- — - — -) is probably chosen because it is not possible to be mistaken for any *one* letter, and is, furthermore, of a neat and easily recognisable appearance. But Mr. ——suggests the letters S N should be employed for the above purpose—a signal which is at present used for "understood" (- - - — -), and is often sent as a preliminary signal on single lines to "keep hold of the wire," preparatory to the transmission of a message or other business. But he further proposes to transform the meaning of the time-honoured, and almost proverbial, "O K" by adopting this phrase for "understood"; then how are we to express "all correct"?

To anybody in the least acquainted with the Morse Code, it will at once become evident what innumerable errors would arise from adopting the letters E J for the sign @. Being exclusively used in company with figures, what is to prevent it being taken for a 2 (- - — — — —) ?

He also appears extremely desirous of "simplifying" the system at present in vogue by such substitutions as A D (- — — - -) for the horizontal bar of division, U S (- - — - - -) for the sloping one, instead of *M M M*, as used at present, or *M* (— —), as employed with short figures. I do not know wherein the fault of the three M's lies, but for the sake of distinction between the two kinds of bars (*e.g.* ¾ and c/o) why not use a simple S (- - -) for the horizontal; as, indeed, they now do use in the Eastern (and I believe the Associated) Telegraph Companies.

Your correspondent wishes also to revert, for some unaccountable reason, to the letter G for "request to transmit," which has been officially disused for some time, though, from force of habit, it is still employed a good deal by some of the older clerks. K is now the conventional signal for this purpose. And in like manner, the letters I I, for separating the preamble from the address, the address from the body, and the body from the signature, have some time been replaced by the signal — - - - —

So that, in conclusion, whilst thanking you in advance for giving my letter a place in your columns, may I just add that, personally, I think it highly probable that the 5-yearly Conference, consisting as it does of many of the most influential *and practical* representatives of the various telegraphic administrations throughout the world, knows far more about all telegraphic interests than does any individual person.

T. A. Hill.

### Telephone Trunk Lines.

Your correspondent, M. Pierart, appears to have overlooked an important fact in his criticism of the recent paper on "Telephone Trunk Lines." In the Van Rysselberghe system, the one object in view is to flatten the current curve and to cause its rise to be so gradual that it shall slowly deflect the diaphragm of the telephone without emitting sound. On the other hand, shunted condensers are used telegraphically in Great Britain, in order to neutralise the self-induction of high speed circuits, and to cause the current curves to reach their maximum value as quickly as possible, so that the rapid reversals necessary to work Morse apparatus at 400 or 500 words per minute may be effective. The nearer the curve, under these conditions, approximates to a vertical line, the higher the possible speed and the greater the inductive effect on neighbouring telephone circuits.

J. Gavey.

## BUSINESS NOTICES, &c.

**Beresford, Boulton & Co. v. Harvard Bros.**—At the Clerkenwell County Court on 22nd ult., the plaintiffs, who are electrical engineers at Highgate, sued the defendants, of the Electric Parade, Seven Sister's Road. N., for £9 17s. 2d., on account of installation work done, and materials supplied. The defendants paid into Court £4 10s. 10d., with proportionate costs, and filed a counter-claim on the ground that the balance represented a portion which had not been satisfactorily done. The Judge gave judgment for the plaintiffs for the amount claimed, with costs, and gave defendants leave to file an amended counter-claim.

## Electrical Wares Exported.

| WEEK ENDING DEC. 22ND, 1895. | £ | s. |
|---|---|---|
| Aden ... ... ... | 16 | 0 |
| Algoa Bay ... ... | 401 | 0 |
| „ Teleg. mtl. ... | 25 | 0 |
| Amsterdam ... ... | 170 | 0 |
| Avendal. Teleg. cable | 3,000 | 0 |
| Bilbao ... ... ... | 45 | 0 |
| Bombay ... ... ... | 44 | 0 |
| Buenos Ayres ... ... | 580 | 0 |
| „ Teleph. mtl. | 60 | 0 |
| Calcutta ... ... | 187 | 0 |
| Cape Town ... ... | 1,887 | 0 |
| Delagoa Bay ... ... | 264 | 0 |
| East London ... ... | 504 | 0 |
| Fremantle. Teleg. wire | 245 | 0 |
| Hamburg ... ... | 480 | 0 |
| Launceston ... ... | 173 | 0 |
| Malta ... ... ... | 100 | 0 |
| Melbourne ... ... | 124 | 0 |
| Para. Teleg. cable ... | 3,000 | 0 |
| Port Natal ... ... | 311 | 0 |
| St. Petersburg ... ... | 19 | 0 |
| Shanghai ... ... | 40 | 0 |
| Singapore ... ... | 28 | 0 |
| Stockholm ... ... | 78 | 0 |
| Sydney ... ... ... | 47 | 0 |
| Total | £11,838 | 0 |

| WEEK ENDING DEC. 22ND, 1896. | £ | s. |
|---|---|---|
| Alexandria. Teleg. mtl. | 80 | 0 |
| „ Teleph. mtl. | 69 | 0 |
| Amsterdam ... ... | 74 | 0 |
| Beira. Teleg. mtl. ... | 260 | 0 |
| Bombay ... ... ... | 142 | 0 |
| Boulogne ... ... | 12 | 0 |
| Brest. Teleg. cable | 33,000 | 0 |
| Brisbane. Teleg. mtl. ... | 256 | 0 |
| Buenos Ayres ... ... | 215 | 0 |
| Calcutta ... ... ... | 175 | 0 |
| Cape Town ... ... | 517 | 0 |
| Colombo ... ... | 8 | 0 |
| Demerara ... ... | 23 | 0 |
| Durban ... ... ... | 887 | 0 |
| Flushing ... ... | 12 | 0 |
| Hong Kong. Teleph. mat. | 9 | 0 |
| Launceston ... ... | 116 | 0 |
| Lisbon ... ... ... | 191 | 0 |
| Melbourne ... ... | 180 | 0 |
| Oporto ... ... ... | 16 | 0 |
| Ostend ... ... ... | 124 | 0 |
| Perth ... ... ... | 40 | 0 |
| Port Elizabeth ... ... | 18 | 0 |
| Port Said ... ... | 16 | 0 |
| Rangoon. Teleph. mtl. | 49 | 0 |
| Rotterdam ... ... | 31 | 0 |
| „ Teleg. mtl. | 24 | 0 |
| Shanghai ... ... | 625 | 0 |
| Singapore. Teleph. mtl. | 21 | 0 |
| Sydney ... ... ... | 2,173 | 0 |
| Trinidad ... ... | 125 | 0 |
| „ Teleg. mtl. ... | 94 | 0 |
| Wellington ... ... | 3,382 | 0 |
| Yokohama ... ... | 137 | 0 |
| Total | £43,101 | 0 |

| Week Ending Dec. 29th, 1896. | £ | s. |
|---|---|---|
| Bombay ... ... | 32 | 0 |
| Buenos Ayres ... ... | 30 | 0 |
| Calcutta ... ... | 473 | 0 |
| Cape Town ... ... | 149 | 0 |
| Durban ... ... | 272 | 0 |
| East London ... ... | 2,130 | 0 |
| Flushing ... ... | 80 | 0 |
| Melbourne ... ... | 189 | 0 |
| " Teleg. mtl. | 45 | 0 |
| Sydney ... ... | 213 | 0 |
| Total ... ... | £3,613 | 0 |

| Week Ending Dec. 29th, 1895. | £ | s. |
|---|---|---|
| Alexandria ... ... | 37 | 0 |
| Algoa Bay ... ... | 25 | 0 |
| Amsterdam ... ... | 40 | 0 |
| Buenos Ayres ... ... | 207 | 0 |
| Bilbao ... ... ... | 246 | 0 |
| Cape Town ... ... | 75 | 0 |
| Colombo ... ... | 60 | 0 |
| East London ... ... | 900 | 0 |
| Hong Kong. Teleg. mtl. | 110 | 0 |
| Madras ... ... | 19 | 0 |
| Melbourne ... ... | 410 | 0 |
| " Teleg. wire | 230 | 0 |
| Oporto ... ... | 30 | 0 |
| Pernambuco. Teleg. mtl. | 85 | 0 |
| Penang ... ... | 60 | 0 |
| Shanghai ... ... | 200 | 0 |
| " Teleg. wire ... | 70 | 0 |
| Singapore ... ... | 15 | 0 |
| Sydney ... ... | 130 | 0 |
| Wellington ... ... | 110 | 0 |
| Yokohama ... ... | 58 | 0 |
| Total ... ... | £3,117 | 0 |

## Foreign Goods Transhipped.

| | | |
|---|---|---|
| Christiana ... ... | £84 | 0 |
| Total | £84 | 0 |

**Liquidation Notices.**—At meetings of the Horsfall Refuse Destructor Company, held at Leeds on November 16th and December 2nd, resolutions were passed and confirmed selling the business of the company to the Horsfall Engineering Syndicate, for the purpose of effecting an amalgamation with the Loidis Engineering Syndicate, Limited. Agreements in respect of the amalgamation were approved, and Mr. S. Denison and Mr. G. Watson were appointed liquidators, for the purpose of winding up the Horsfall Refuse Destructor Company.

A general meeting of the Horseless Carriage and Motor Cycle Company will be held at the office of E. T. Hargreaves, 18, St. Thomas Street, London Bridge, S.E., on February 2nd, at 10.30 a.m., for the purpose of having an account of the winding up laid before the shareholders.

At meetings of the Manchester Edison-Swan Company, held at Manchester on November 24th and December 21st, resolutions were passed approving the amalgamation of the company with the Edison and Swan United Electric Light Company, Limited. The joint liquidators for conducting the necessary winding up operations of the old company are J. E. Sharples, of Manchester, and H. C. Gover, of London.

The Smillie Patent High-Pressure Pipe and Tube Company, on December 21st, decided, at Glasgow, that the company's liabilities are such that it cannot continue the business, and that it is desirable to wind up voluntarily. Mr. P. Buchanan was appointed liquidator.

**Portable Test Set.**—Messrs. Elliott Bros. have just issued an illustrated list of their portable test set, which combines a portable pattern Wheatstone bridge, with a sensitive suspended needle galvanometer, with astatic system. It is intended for the measurement of conductor resistances from ·01 up to 90,000 ohms, and for insulation resistances up to 50 megohms. The apparatus has been designed with a view of being very quickly used and easily got at, should anything give way in the galvanometer. The two sides of the apparatus are quite distinct. There is a pair of terminals for the bridge battery, and a pair of terminals to which the resistance to be measured should be attached. A key marked "Bridge" is then used for testing. For testing insulations, a battery of 100 or more cells can be attached to the terminals marked for the purpose, and wires can be run from the line and earth terminals to the conductor, whose insulation is to be measured. By means of suitable shunts and calibrating coil included in the box, complete tests of insulation can be very readily carried out. It is only necessary to place the instrument on a comparatively level surface.

**Wigston Electrical and Engineering Company, Limited.**—The liquidator of this company (Mr. Arthur B. Wykes) has issued a notice to the effect that he has sold the plant, tools, patterns, drawings, &c., of the company to Messrs. Girdlestone & Co., electrical engineers, of 16, Davies Street, Berkeley Square, W., who will carry on the business under the style and title of the Westminster Engineering Company, Limited, as electrical and general engineers. All debts due to the old company, up to November 28th, should be sent to the liquidator at 24, Friar Lane, Leicester. The new company announces that it has secured the services of Mr. F. V. Andersen as consulting electrical engineer, and the company will continue the manufacture of the "Westminster" dynamo and motors as supplied to the Admiralty; also Andersen's arc lamps and other specialities. The company is giving special attention to electric motors for traction work.

**Xtralite Reflector.**—This reflector, which has been introduced by the General Electric Company, Limited, and which is already selling well, is made of white porcelain, and is intended to drop over incandescent lamps of various candle-powers, resting on the bulb and thus concentrating the rays of light in a downward

direction. It can be removed for cleaning in a moment by unsocketing the lamp. There is a free current of air always circulating between the lamp and the reflector, consequently the lamp does not attain a very great heat. For inverted positions a small spring attachment is provided for holding the reflector in position.

**Business Announcement.**—Johnson & Phillips inform us that owing to the very large increase in the demand for their vulcanised cables and wires, and in order to meet the requirements of those firms wanting a few coils at a few moment's notice, they have opened a cable and wire stores at their London address, 14, Union Court, Old Broad Street, E.C.

**Curtis & Sons v. Armstrong & Co.**—This case, to which we referred last week, was resumed at Dublin on 22nd ult. It will be remembered that defendants brought into Court £670 as sufficient to satisfy plaintiffs' claim, and filed a counter-claim for £1,000 damages in respect of breach of contract, and £1,010 in respect of penalties from June 1st, 1895. The jury found for the plaintiffs for £567—£670 having been lodged in Court—and for the defendants 6d. damages on their counter-claim.

Portable Test Set.

**Personal.**—We understand that Mr. E. T. Owbridge, lately representative of the General Electric Co., Limited, and Messrs. B. Verity and Sons, has been appointed London manager for Messrs. MacGeoch and Co., of London, Glasgow, and Birmingham, who are opening large showrooms for high-class fittings and electrical accessories, &c., at 11, Charing Cross Road, London, W.C.

Mr. H. W. Ravenshaw, of Booth & Ravenshaw, informs us that he has resigned his position as consulting engineer to Messrs. P. R. Jackson & Co., Limited, and now holds no retaining fee from them.

**Calendars, &c.**—The Eastern and Eastern Extension Telegraph Companies have sent us as usual one of their useful paper-knives, with 1897 calendar thereon.

The G. E. Co. are sending their greetings to the trade and friends in the form of an elaborate set of photographic illustrations, which are neatly put together in stiff paper covers, with the gilt letters G. E. Co. in bold relief. The directors of the Company, including the Messrs. Binswanger-Byng, Hirst, and Eckstein, are on the opening page, and these are followed by well arranged views of the various departments at the London and Manchester works, along with midget photographs of many of the officials. The publication is attractive and a capital advertisement.

The *Daily News* hanging almanack for the year 1897 is before us. The publishers have taken advantage of the importance which attaches to the sixtieth year of the Queen's reign, and given capital photographs of members of the Royal Family.

Messrs. Hodges and Todd are sending out a beautifully designed card wishing a prosperous New Year.

The Electrical Power Storage Co., Limited, are as usual issuing their extremely serviceable blotting pad and calendar for 1897, with the memorandum book fixed on the left, a number of sheets of which contain particulars of the Company's specialities. We have ourselves found the pads very useful for some years.

**Gas.**—An explosion at Lugard Road, Peckham, on Sunday night, wrecked several rooms and slightly injured a resident.

On 19th ult. a gas explosion occurred in a house at Dumbarton. The premises were injured, as also were the occupants.

On 24th ult. some new shop premises were damaged and two persons injured by a gas explosion at Newport.

A very serious gas explosion occurred at a residence at Canton, Cardiff, on 25th ult.

On 27th ult. a house in Clive Road, Portsmouth, was wrecked by a gas explosion. Several occupants were injured.

A gasometer of the Lisbon Gas Company exploded on the 29th ult. Three deaths have already resulted, and three others are seriously injured.

**Mr. Slater Lewis's Book.**—In our review of Mr. J. Slater Lewis's book, on the "Commercial Organisation of Factories," we omitted to give the names of the publishers, who are Messrs. E. F. and N. Spon, Strand, W.C.

**Pocket-Book.**—The Brush Electrical Engineering Company, Limited, has issued, as usual, a neat and useful vest pocket-book and calendar for 1897, with gilt edges. We believe many electrical men find, with us, that such a book is very handy, being convenient in regard to size, *i.e.*, 3 inches × 2 inches.

## ELECTRIC LIGHTING NOTES.

**Bedford.**—We hear that the Electric Light Committee recommends that, by way of discount for cash, a lamp be given for each 15s. paid for current consumed.

**Birkenshaw.** — The District Council is asking the Gomersal Council to join in formulating a scheme for electrically lighting the two districts. If Gomersal declines to join, Birkenshaw will probably act alone. Water power is suggested.

**Bournemouth.**—The Bournemouth and District Electric Supply Company, Limited, having, as stated last week, had their assessment reduced by the magistrates sitting at Branksome, the Guardians have decided to appeal to the Quarter Sessions.

**Bray.**—At the Local Government inquiry regarding the application for a £5,450 electric lighting loan for extensions, Mr. G. M. Harris, the municipal electrical engineer, gave detailed evidence as to the nature of the proposed extensions.

**Brighton.** — Electric lighting returns, made up to December 19th, show a net increase of 300 customers during the year, the highest total added during any previous year having been 230. There were altogether 1,357 private customers on the date mentioned. A start is expected to be made in the new year with 1,357 customers, as compared with 1,050 on January 1st, 1896. The past year has been one of great progress in the matter of street lighting, both in the extension of arc lighting and the fitting of incandescent lamps in existing street lamps.

**Croydon.**—St. Matthew's Church, Croydon, is to be lighted throughout by electricity, the contract being placed in the hands of Messrs. Peto & Radford.

**Douglas.**—An exhaustive report, prepared by Mr. Thomas H. Nesbitt, Town Clerk, on the electric lighting of Douglas, has been issued. Feeling both on the Town Council and with the public is evenly divided upon the subject, but the report of Mr. Nesbitt is strongly in favour of electric lighting. Information received from the Town Clerks of Liverpool, Manchester, and important centres has been collected and analysed. The report is in favour of the municipalisation of all public undertakings, including electricity, workmen's dwellings, public baths, and waterworks. In Douglas, however, the report states, exceptional circumstances prevail, and the Isle of Man Tramway and Electric Power Company should be entrusted with the work of supplying Douglas with electric light on satisfactory terms being agreed upon.

**Derby.**—It is understood that the Electric Lighting Committee intends asking for sanction to obtain a further loan of £20,000 for the development of the electric lighting of the town.

**Fyvie Village.**—A meeting of villagers has been held at Lewes, Fyvie, for the purpose of considering as to the lighting of the village, and whether that should be done by means of gas or electric light. A committee was appointed to make all necessary arrangements in getting an estimate for both systems.

**Killarney.**—One of the effects of the sliding bog, of which we have heard so much this week, was the blocking of the River Fleak with masses of bog and farm produce, which brought to a standstill operations at the electric light works situated on the river bank, as the works depend upon the water-power for driving its dynamos. In consequence, some of the large public institutions were thrown into darkness.

**Kingston.**—The Electric Lighting Committee reports having arrived at an arrangement with the consulting engineer, Mr. A. H. Preece, in regard to his relations with them.

**Leatherhead.**—Messrs. New & Mayne have asked permission to lay a conduit under Woodlands Road. The Surveyor has asked for a plan showing the position of the mains.

**Leeds.**—At a meeting of the Lamp Committee, last week, a lengthy discussion took place respecting the lighting of Boar Lane and Wellington Street. It was thought that so central a part of the city was not as well lighted as it ought to be, and it was suggested that some of the electricity generated at the power-station which is being erected for supplying the new tram cars, should be utilised for lighting purposes. A sub-committee was appointed to confer with the Highways Committee upon the matter.

**London.**—Messrs. Lambert & Butler have had their new export tobacco factory electrically lighted throughout. There is also an intercommunication telephone system between each floor. The work was carried out by Mr. T. H. Taylor, of West Kensington.

**Moss Side.**—An agreement with the Manchester Corporation, with respect to the electric lighting order, was last week passed under the common seal of the Moss Side Council. The agreement provided that the Corporation should take a transfer of the order, and become the undertaker of supplying the district with electric light for a period of 15 years, refunding to the Council the cost of obtaining the order and transfer of the deed, on condition that the charges of the district should be in all respects the same as those made within the city; that the Council should re-purchase the undertaking within six months after the term of 15 years, or any subsequent fifth year; and that within two years preceding any purchase period, no expenditure exceeding £100 on capital account should be incurred without the approval of the Moss Side Council, except in case of emergency, with a special provision in that event, and that the Corporation should not mortgage the Moss Side general district rate, nor the Moss Side portion of the undertaking.

**Newmarket.**—The District Council recently discussed the application which is being made for electric lighting powers, and the preliminary arrangements were settled. It was stated that the cost of the installation will be about £10,500.

**Poole.**—The Town Council has consented, with certain provisions, to the application of a Company for a provisional order now being promoted.

**Reading.**—The number of lamps in use in the town has more than doubled since last December, viz., from 4,300 to 9,000, and applications for 800 more have been received.

**Southampton.**—The County Council had a number of matters relating to electric lighting before it last week. The minutes of the Electric Light Committee showed that £614 12s. 7d. was due from consumers for the quarter ended the 29th September. The Engineer reported that Messrs. Ferranti had quoted £5 net for meters in lots of not less than 12. The Resident Engineer further reported that the total number of units sold during October was 12,948. The Committee resolved to subscribe the sum of £1 1s. per annum to the Municipal Electrical Association.

**Swansea.**—The triple scheme has been hanging fire for a long time, and the Local Government Board has now addressed the following communication to the Town Clerk respecting it:—

Local Government Board, Whitehall, S.W.
*May 14th*, 1896.

Sir,—I am directed by the Local Government Board to state that they have had under consideration the report made by their inspector, Colonel Ducat, after the inquiry held by him with reference to the application of the Town Council of Swansea for sanction to borrow £60,000 for purposes of electric lighting and the erection of a refuse destructor.

I am to inquire whether the Town Council have now decided upon the precise form of destructor which they propose to adopt; and, if so, to request that the Board may be furnished with a detailed estimate of the cost of the proposed structure. The Town Council should at the same time specify separately the amount which they desire to borrow (1) for the purposes of electric lighting and (2) for the purposes of the destruction of refuse.

Particulars should also be furnished as to the nature of the refuse intended to be dealt with in the destructor. It should be clearly stated whether it would include any wet privy refuse; and, if so, the approximate quantity should be specified.

The Board also desire to be informed whether the Town Council

have entered into a provisional agreement for the purchase of the additional land required as a site for the destructor and electric lighting station. If so, the price agreed to be paid should be stated. The tracing, showing this land and the land already vested in the Town Council, is returned herewith in order that the exact boundaries of the corporate land to be appropriated may be shown upon it.

I am further to request that the Board may be furnished with particulars, in one of the forms enclosed for the purpose, as to the assessable value and existing debt of the borough for sanitary purposes. The return should be verified by a statutory declaration.—I am, sir, your obedient servant,

(Signed) Alfred D. Adrian,
*Assistant-Secretary.*

J. Thomas, Esq., Town Clerk, Swansea.

**Watford.**—The Electric Lighting Committee has had a scheme under consideration for a combined electric lighting and sewage works. Mr. Hawtayne, consulting electrical engineer, has interviewed Messrs. Shone and Ault on several occasions, and a rough general plan of the buildings has been prepared. A committee of the whole Council will consider the scheme.

## ELECTRIC TRACTION AND MOTIVE POWER NOTES.

**Blackburn.**—The deputation appointed by the Gas Committee of the Blackburn Corporation to inspect the electric tramways worked on the overhead wire system at Bristol, Coventry, and Walsall have presented their report to the committee. The report, after describing the systems, proceeds: "With regard to the overhead wire system generally, the sub-committee find that there is no noise or flashing to speak of, and the cars run better than with either horse or steam traction. The sub-committee particularly noticed, and are informed that these cars do not frighten horses, and they can be pulled up and started much sooner than in other forms of traction. For instance, they can be pulled up within a distance of a yard or two when going at a rate of 12 miles an hour even on gradients of 1 in 14. Some of them, particularly at Coventry, have to ascend and descend very sudden and sharp gradients, much worse than any gradients on the Blackburn tramway lines; that is to say, the gradients at Coventry are not gradual gradients, but are sharp and sudden rises. When extraordinary traffic requires it, trailer cars are attached to the ordinary cars, but the trailer car and the ordinary car combined are not longer than an ordinary steam tramcar." The Gas Committee, after consideration of the report, decided to proceed with the "overhead" system in Blackburn.

**Cardiff-Penarth.**—The Parliamentary and Tramways Committee of Cardiff had an interview with the Tramway Syndicate's deputation on Tuesday, last week, when the promoters and engineer explained the proposed scheme. Mr. L. B. Atkinson defended the overhead wire system, and further stated that the Syndicate were prepared to make the Corporation the offer of taking over all that portion of the proposed line that would be in the Borough, and if the Borough were extended to Penarth to offer them the whole of the line. The deputation having withdrawn, there was a brief discussion, which was adjourned pending a further report by the Borough Engineer.

**Clontarf and Howth.**—A large public meeting held at Howth on the 21st ult. supported the proposed electric tramway from Clontarf to the Hill of Howth, at a cost of something like £80,000 or £90,000. This scheme was before the judicial Committee of the Privy Council on 23rd ult., when there was opposition. After lengthy argument the Lord Chancellor said that, inasmuch as there was admittedly direct railway communication between Sutton and Howth, and as that included part of the route of the proposed tramway, it was not necessary for them to consider the wider question as to direct competition between Dublin and Howth. If the parties desired there was nothing to prevent them going to Parliament and proceeding by a bill. It was stated that the promoters intended to go to Parliament.

**Electric Lifts.**—The new Infirmary Buildings of the Halifax Union are to be fitted with six passenger lifts and two service lifts, all worked by electricity, and supplied and fixed, with all necessary motors and gear. The large block of residential flats now being built at Bedford Court, London, will be equipped with three electric passenger lifts and one electric goods lift. The work includes motors, electric lights, bells, and indicators.

An electric passenger lift is to be placed in the Manchester Technical Schools, the work having been entrusted to Messrs. Easton, Anderson & Goolden, Limited.

**Electric Pumps.**—The Pooley Hall Colliery Company will shortly increase their existing electrical plant at Stockingford by putting down three large motors and a 20 unit dynamo, now being made by Messrs. Easton, Anderson & Goolden, Limited. The electric pumping plant at this pit was supplied by the same firm.

**Middlesbrough.**—At a meeting of the Streets Committee last week the question of granting permission to the Imperial Tramway Company to extend the tramways in the town, and adopt the overhead electric trolley system of traction was again considered. It was ultimately agreed that the Chairman and Town Clerk formulate questions for reply by the Tramway Company.

**Motor Cars.**—The Leatherhead County Council does not like motor cars and thinks that their use should be prohibited between the hours of sunset, or 5 p.m., and 1 a.m. The District Council agrees with this suggestion.

**Paddington and Willesden Proposed Electric Railway.**—A Bill for incorporating the West Suburban Railway Company, and for empowering them to construct a railway from Praed Street, Paddington, to Acton Lane, Willesden, has been deposited for next session. By this Bill the company proposed to be incorporated to seek power to construct a railway following the course of the Grand Junction Canal from the northern side of Praed Street, through Chelsea and Hammersmith, to Acton Lane Bridge, which crosses the canal at Willesden. The proposed railway will be 4 miles 4 furlongs 1½ chains in length, and will be worked by electrical power, supplied from a generating station at Willesden. The capital of the company will be £350,000, divided into £10 shares, but with the right to subsequently divide the shares into "preferred half shares" and "deferred half shares." Upon the capital raised it is proposed to exercise borrowing powers to the extent of £116,666. The first directors of the company, who are also mentioned in the Bill as the promoters, will be Mr. T. Clayton, Mr. J. Fellows, and Mr. F. Watkins. The time sought for the construction of the railway is five years from the passing of the Bill, and during this period it is proposed to pay 3 per cent. interest out of capital to an amount not exceeding in the whole £16,000. From the schedule of fares inserted in the Bill it appears that the company intend to charge at the rate of 1d. per mile for third class passengers, but with a minimum fare of 2d. for any distance less than 2 miles.

**Proposed City and West End Railway.**—By the City and West End Railway Bill which has been deposited for next Session, power is sought to incorporate a company for the purpose of constructing an underground railway over six and a quarter miles in length, commencing under Bridge Road, Hammersmith, and terminating under Cannon Street at a point near Budge Row. The capital required by the company is £3,150,000, upon which it is proposed to borrow a further sum of £1,050,000. The promoters named in the Bill are Messrs. T. Davidson, R. E. Tarrant, J. H. Lukach, F. E. Warburg, E. Cassel, D. O. Mills, J. Rochefort Maguire, Carl Meyer, H. Oppenheim, H. C. Perkins, H. Smith, and Sir H. T. Farquhar. Of these promoters the first four will form the first board of directors. It is proposed (says the *Times*) to work the railway, if constructed, by means of electricity, and during the five years within which it is proposed to complete the line power is sought to pay interest out of capital to the extent of £166,000.

**Thanet.**—A Kent paper anticipates that this electric railway scheme will be opposed by the Ramsgate Town Council.

**Whitechapel to Bow Electric Railway.**—A Bill for powers to construct a railway from Whitechapel to Bow has been duly deposited for next session in the Private Bill office of the House of Commons. Under this Bill a company is proposed to be incorporated for the purpose of constructing an underground electric railway, just over two miles in length, commencing by a junction with the Metropolitan District Railway, near the eastern corner of Whitechapel road, and terminating in Bromley, by a junction with the London, Tilbury and Southend Railway, near Campbell Road. The capital sought to be raised is £600,000, with power to borrow a further sum of £200,000. The first directors of the new company will be Sir Myles Fenton, Mr. Lewis Henry Isaac, the Hon. Cornwallis Ponsonby, and four other persons to be nominated by them. The period sought for the construction of this line is five years, during which time it is proposed to pay interest out of capital to the extent of £50,000.

## TELEGRAPH AND TELEPHONE NOTES.

### Telegraphic Interruptions and Repairs:—

| Cables. | Down. | Repaired. |
|---|---|---|
| Brest-St. Pierre (Anglo, 1869) | April 6th, 1895 ... | ... |
| Puerto Plata-Martinique ... | Dec. 19th, 1895 ... | ... |
| Amazon Company's cable— | | |
| Parintins-Itacatiara ... | May 5th, 1896 ... | ... |
| Obidos-Parintins ... | Dec. 7th, 1896 ... | ... |
| Maranham-Ceará ... ... | Dec. 2nd, 1896 ... | ... |
| St. Croix-Trinidad ... ... | Nov. 30th, 1896 ... | ... |
| Suakim-Djedda ... ... | Dec. 5th, 1896 ... | ... |
| Mozambique-Lorenzo Marquez | Dec. 24th, 1896 ... | ... |
| **Landlines.** | | |
| Trans-Continental line beyond Masol | March 12th, 1896 ... | ... |
| Carthagena - Barranquilla (Columbia) | July 4th, 1896 ... | ... |
| Salisbury-Umtali ... ... | July 11th, 1896 ... | ... |
| Siberian lines — Irkoutsk-Werkne-Oudinsk. | Dec. 21st, 1896 ... | Dec. 23rd, 1896. |
| Mexican lines interrupted near Campeché. | Dec. 27th, 1896 ... | Dec. 29th, 1896. |

December 5th, 1896.—Katarina-Larissa route working badly.

December 30th, 1896.—The Emden-Vigo cable will be open for traffic on January 1st next.

**Cable Company Litigation.**—Judge Lacombe, of the United States Circuit Court, has refused to grant an injunction preventing the United States and Hayti Telegraph and Cable Company from doing business in the United States.

**Cable Interruption.**—Early in December the telegraph at Barbados was interrupted. The *Barbados Globe* on December 3rd said that no telegrams were received there for three days. "The heavy weather at the beginning of the week seems to have put everything telegraphic completely out of gear. We know of nothing further than our own shores."

**Deutsche See-Telegraphen-Gesellschaft.**—We reproduce a telegram from Berlin which appeared in the daily press last week:—The submarine cable directly connecting Germany and Spain has just been laid, and the first telegrams have been exchanged by means of it between the Postmasters-General of the two countries. Its ends are at Emden and Vigo. It is about 2,000 kilometres long, and was laid by the German Sea Telegraph Company, formed especially for the purpose by the Eastern Telegraph Company and the South and Western Brazilian Telegraph Company, both of London, the Telegraph Construction, &c., Company, of Woolwich, and the well-known German cable constructors, Felten and Guilleaume, of Muelheim, on the Rhine. As all the German telegraphs belong to the State, German State officials do the work at the Emden end, whereas that at Vigo is done by private officials. The telegrams are not dearer than hitherto, and are less liable to delay and mutilation, due to retelegraphing or to meteorological disturbances. The work, now happily ended, has lasted seven years, and is the first step towards the extensions of the German telegraphic system to transoceanic countries, for the cable will certainly be prolonged to the Azores and the United States. In the above, it would seem that the South and Western Brazilian Telegraph Company is a misnomer for the Brazilian Submarine Telegraph Company, which, we understand, is one of the parties in the above enterprise. The laying of this cable under the circumstances detailed above is notable as showing the freedom from Government interference under which English companies are allowed to work. That English companies working under a German concession are permitted to lay a cable, of which the present effect is to deprive English lines of a certain amount of traffic, and of which the avowed effect in the future will be to deprive the trans-Atlantic cables of a great proportion of their European receipts, is an example of the liberal spirit of the English Administration, which ought to be appreciated. We are rather inclined to doubt, however, whether the shareholders in the Anglo-American Company will be able to muster philosophy enough to look at the question in this enlightened spirit; rather may it arouse in them a regret that the large prices they have paid in the past for their cables to the Telegraph Construction and Maintenance Company should have been a means of aiding what may become a very powerful rival Atlantic Company. We understand that the Marquis of Tweeddale, who is chairman of the Eastern Telegraph Company, and, therefore, interested in the Deutsche See-Telegraphen-Gesellschaft, recently resigned his position as Chairman of the Anglo-American Telegraph Company. We learn that the new cable will be open for traffic on January 1st.

**Dinner to the Cable Delegates.**—The dinner given by Sir George Baden-Powell, M.P., some nights before Christmas, to the Pacific Cable delegates was a great success in every way. The motto on the menu was "Success to the girdling of the earth," and, says *Colonies and India*, was much appreciated by the delegates. Those present at the dinner were:—Mr. Sandford Fleming, Mr. J. G. Colmer, Professor Roberts-Austen, Mr. W. H. Preece, Sir Robert Herbert, Mr. D. Gillies, Sir Donald A. Smith, Hon. G. A. Kirkpatrick, Lord Glenesk, Sir George Baden-Powell, Hon. A. G. Jones, Sir D. Tennant, Mr. R. K. Gray, Hon. R. R. Dobell, Mr. W. Peace, Professor E. Ray Lankester, Capt. B. Baden-Powell (Scots Guards), Mr. Th. Skinner.

**French Cable Enterprise.**—We make the following extract from *Commerce*:—"In the French Chamber on Friday, on the vote for the Senegal Cable Company, M. Habert dwelt on the bad policy of intrusting to foreign companies duties of a really national character. He disclaimed any idea of forecasting a great maritime war, but he asked what would happen if all these telegraph lines were then in English hands. M. Boucher, Minister of Commerce, replied that the West African Company had just 'capitulated,' by agreeing to pay 500,000 francs within a week of the approval of the treaty by the Chamber. France had for 10 years paid a subsidy of 300,000 francs for a cable only partially laid down, the messages by which travelled by an indirect route. He agreed with M. Habert that France was in a deplorable state of inferiority in regard to submarine cables, and that considerable sacrifices ought to be made to insure the arrival of news of all kinds as expeditiously as in England."

**Inefficiency of Australian Trunk Landlines.**—We have so frequently had to call attention to the unsatisfactory condition of the Australian landlines, that one collapse more or less may seem a small affair. Now, on an occasion when accuracy was to be expected from him, the Hon. Thomas Playford maintained stoutly that, on account of the unreliable state of the Western Australian landlines, the line from Port Darwin across South Australia carried the whole of the European messages. With this information before us—coming from such an authority—it is difficult to explain the apparent unconcern with which the commercial community in England and in Australasia tolerate the interruptions and delays on the South Australian line, which we have so often had to refer to. On November 5th the following report was made to the Postmaster-General of West Australia by the Acting-Inspector of Telegraphs: "All our lines working well and are clear. The South Australian section of the inter-Colonial line worked poorly during last night. Adelaide is clear outwards, but had 250 messages to receive from Eucla." From this it will be seen that the service on the South Australian landlines is not good. The reason why this line was described as the best route from Australia and New Zealand to Europe is difficult to divine; perhaps it has been so described on the principle that "among the blind the one-eyed man is king." Since the above was written, we learn from the Australian press that the trunk landline from Port Darwin across South Australia has again been interrupted. At 9 p.m. on November 14th, the Postmaster-General of New South Wales received the following message from Adelaide:—"Port Darwin line interrupted north of Charlotte Waters; expect it will be restored early early to-morrow. Traffic diverted *viâ* Roebuck." On the 18th a telegram was received from Adelaide to the following effect:—"The fault on the Port Darwin line was removed at 7.42 p.m. We have worked slowly through the fault throughout the day." We give here a list of interruptions to Australian landlines for 1896, as far as can be gathered from the press:—

1896.

January 14th.—Port Darwin route interrupted.
January 18th to 19th.—Port Darwin route interrupted.
January 22nd.—Port Darwin route interrupted.
January 27th.—Urgent business telegrams for West Australia suspended.
February 18th to 27th.—West Australian route interrupted.
March 13th.—Port Darwin route interrupted.
June 1st to 2nd.—Port Darwin route interrupted.
November 5th.—South Australian Inter-Colonial line working poorly.
November 14th.—Port Darwin line interrupted.
November 18th.—Port Darwin line restored.

There may be many others which have escaped our attention, and of which, as in the case of the above, no notice has been received from the "Bureau International des Administrations Télégraphiques," of Berne, which, according to the International Telegraph Convention, Article 82, paragraph 4, should receive from the Administration by telegraph "notices of all interruptions and restorations of communication affecting International traffic."

**The Pacific Cable.**—The Delegates appointed to inquire into a scheme for improved telegraphic communication between Great Britain, Canada, and Australasia by means of a Pacific cable, resumed their deliberations at the Colonial office on Tuesday, and proceeded with the consideration of their report.

**The Cable Steamer "Seine."**—The Telegraph Construction and Maintenance Company's steamer *Seine* is due home again. She proceeds direct to Calais to discharge surplus cable, &c. After having completed the laying of the New York-Haiti cable, the *Seine* was further charged to effect some shallow water repairing work in the West Indian cable system of the Compagnie Française des Cables Télégraphiques.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Belgium.**—January 4th. The Provincial Government Authorities in Brussels are inviting tenders for an installation of electric lighting in the Hotel des Ponts et Chaussées in Brussels. Tenders to be sent to the Gouvernement Provincial, 17, Rue des Augustins, Brussels.

**Blackburn.**—January 9th. Tenders are invited for the laying of a service of electric fire-alarm communication between the various buildings of the workhouse, for the Guardians. Plan and report showing the requirements of the Guardians may be seen and information with regard thereto obtained upon application to Inspector Simpson at the Borough Fire Station, Clayton Street, Blackburn, by appointment.

**Bristol.**—January 21st. The Electrical Committee want tenders for five Lancashire boilers for the electric light station. For particulars see our "Official Notices."

**Christiania.**—January 7th. Tenders are invited by the Director of the Norwegian State Railways for the delivery of about 4,280 tons of steel rails with the accompanying fish plates. Further particulars may be seen at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 6 p.m.

**Edinburgh.**—January 28th. The Managers of the Royal Infirmary are inviting tenders for the complete wiring of the Infirmary buildings. Particulars from the treasurer and clerk (Mr. W. S. Caw), or Prof. Kennedy, 17, Victoria Street, S.W.

**France.**—January 31st. Tenders are being invited until January 31st next, for the contract for an installation of electric lighting in the Asile d'Aliénés at Saint Jvon (Seine Inférieure).

**Germany.**—January 11th. The Prussian State Railway Authorities at Kattowitz are inviting tenders for the supply of a quantity of arc lamp carbons. Particulars for 6d. from, and tenders to be sent to, the Konigliche Eisenbahn Direction, Kattowitz.

**Germany.**—January 12th. The Breslau Direction of the Prussian State Railways is inviting tenders for the supply of a quantity of porcelain insulators and telegraph wire. Tenders to be sent to the Konigliche Eisenbahn Direction, Gartenstrasse, 106, Breslau.

**Halifax.**—January 12th. The Corporation want tenders for a 300 kw. slow speed steam alternator. See our "Official Notices" for further details.

**Harrogate.**—January 1st. The Council wants tenders for wiring the Municipal Offices, Victoria Baths, Market Hall and Public Library, also for electrical fittings for the same.

**Hull.**—February 1st. The Corporation of Hull is prepared to receive tenders for a lease of the tramways authorised to be constructed by the Tramways Orders Confirmation (No. 1) Act, 1,896.

**Jamaica.**—April 15th. The Privy Council invites applications for a license for the establishment and working of a system of rapid transit in Kingston and environs. Copies of the Tramways Law, 1895, and of local rules and maps of Kingston and environs may be seen at the offices of the Crown Agents for the Colonies, London. See our "Official Notices."

CLOSED.

**Aberdeen.**—The following tenders have been accepted by the Gas and Electric Lighting Committee:—The Electrical Power Storage Co., to keep the storage batteries in good working order for five years at £60 per annum. (It now costs the Council £78 per annum.) Messrs. P. C. Middleton & Co., to supply wiring in connection with the electricity station extension at £45.

**Edinburgh.**—The following tenders have been accepted by the Town Council for additional machinery necessary for next year:—Boilers—George Sinclair, £2,453; steam dynamos—Siemens Brothers & Co. (Limited), £4,540; alternator—S. Z. de Ferranti (Limited), £2,023.

**London.**—The London County Council has accepted a tender, amounting to £350, from the Permanent Enamelled Iron Company for the supply of coloured rolled iron covers for the electric cables required in connection with the lighting of the Blackwall Tunnel.

## NOTES.

**A Happy New Year.**—We take this opportunity of wishing all our readers and others connected with the electrical profession a happy and prosperous New Year.

**Power Transmission in Africa.** — Mr. H. Rider Haggard, chairman of the Africa Trust Company, Limited, addressing the shareholders last week, said the company had a very large interest in an undertaking called the African Concessions Syndicate. The object of this syndicate is to carry out a scheme to use the water power of the Victoria Falls on the Zambesi River, with the object of utilising that power to generate electricity, and supply it to the various centres of population throughout Rhodesia, either in the form of power to work stamps and mills, or of motive power for other purposes. This great scheme had been modelled upon that already achieved at the Falls of Niagara, which, vast as they are, he believed, are surpassed in size by the Victoria Falls of Zambesi. This undertaking has been reported upon by Prof. Forbes, F.R.S., who proceeded to Africa for the syndicate during the year 1895. Subsequently, also, it has been favourably reported upon by Dr. Hopkinson, F.R.S., C.E. Of course, the success of this enterprise is measurable by the success of Rhodesia. If Rhodesia proves a failure, it will fail; if, as most of them were convinced, Rhodesia proves one of the greatest colonising achievements of this colonising race, this scheme will prove a success.

**Lectures.**—On 23rd ult., at the Engineering Laboratory of the University College, Cardiff, Mr. Sydney F. Walker read a paper on "Electric Welding."

On 23rd ult., Mr. A. E. Briscoe read a paper on "The Greatest Magnet in the World," before the Scientific Society of the Birmingham and Midland Institute.

**An Acetylene Society.**—A new technical society has just been formed in Paris to be known as the Société Technique de l'Acetylene et des Industries qui s'y attachent, for the furtherance of the acetylene movement.

**Erratum.**—In the leader on "Communication between Coast and Lightships" last week, p. 821, col. 1, line 20, for "continuous" system read "non-continuous" system.

**Appointment.**—Mr. William J. Rawlinson Thomas, A.I.E.E., formerly of St. Pancras electric light station, has been appointed electric inspector and adviser to the Birmingham City Council.

**Obituary.**—We regret to hear that Prof. Emil Du Bois-Reymond died in Berlin on Saturday morning last. He was born in 1818, in Berlin. After pursuing studies in medical and natural science he, in 1841, commenced his researches on animal electricity. When the time came for Du Bois-Reymond to take his doctor's degree, he embodied the results of his investigations in a thesis entitled "Quæ apud veteres de piscibus electricis extant argumenta." His discoveries included the true law of the muscular current, its negative variation during contraction, and of the nervous current. He was one of the founders and honorary presidents of the Berlin Physical Society. In 1851 he was elected a member of the Berlin Academy of Sciences in recognition of his work on animal electricity. He showed his experiments before the Royal Institution in London on two occasions. Among his works are "A Description of some Apparatus and Experiments in Electro-Physiological Researches"; "The Electrical Organs of Fishes"; and "The Time Required for the Transmission of Volition and Sensation through the Nerves."

**Transmission of Power.**—The Keewatin Power Company has definitely decided, says the *European Mail*, upon undertaking to convey 5,000 horse-power of electrical energy from its dam at Keewatin to Winnipeg, provided the users of power there will agree to take it and the city will grant the privileges usual in such cases. All questions as to the feasibility of the undertaking seem to be removed, as the company has tenders for the work which guarantee to deliver the power at Winnipeg with a loss not exceeding 20 per cent. of the 8,000 horse power provided at Keewatin, which is just 130 miles east of Winnipeg.

**The Falls of Foyers.**—The *Glasgow Record*, in reviewing electrical engineering work during the year, refers to the development of the aluminium industry, and says that at the Falls of Foyers there is at the present time plant of 3,500 horse-power working day and night at the industry, and an additional 1,400 horse-power is being put down under the supervision of Mr. W. Murray Morrison.

**Refuse Destruction.**—The Sydney City Council is sending its surveyor, Mr. R. W. Richards, to England, to inquire into the question of refuse destruction.

**Communication between Coast and Lightships.**—In reference to "F. Le-B. B.'s" letter on page 19, on looking up the evidence of Mr. E. A. Stevenson, electrician to the T. C. and M. Company, in charge of telegraph cable to the *Sunk* lightship between 1884 and 1886, we find that he says: "The experiments commenced December, 1884, and terminated March, 1886. . . . . Considering the difficulties that had arisen, he was of opinion that the system was very successful."

## NEW COMPANIES REGISTERED.

**Galway Electric Company, Limited** (2,027).—This company was registered in Dublin on the 21st inst., with a capital of £8,000 in £1 shares, to carry on the business of electrical and mechanical engineers, in all its branches, in such manner and place as the company shall deem fit. The subscribers are:—John Perry, Royal College of Science, S.W., Professor of Mechanical and Mathematics, F.R.S., 50 shares; James Perry, Wellpark, Galway, county surveyor, 50 shares; Alice M. Perry, 8, Gilston Road, London, S.W., married woman, 50 shares; Martha Perry, Wellpark, Galway, married woman, 50 shares; Agnes Perry, 35, Wellington Place, Belfast, widow, one share; Janet Park, Wellpark, Galway, spinster, one share; Eliza Jowitt, Linden Park, Sheffield, spinster, one share. The number of directors shall not be less than three nor more than seven; qualification 50 shares; remuneration to be fixed by the company. Registered by Blake and Kenry, 4, Dame Street, Dublin.

**Millet's Patent Motor Wheel Company, Limited** (50,583).—Registered December 18th; capital £100,000, in £1 shares, to adopt an agreement with F. T. Millet and A. E. Greville to acquire, develop, turn to account, and deal with any patents and inventions, and to carry on the business of motor, cycle carriage, and accessory manufacturers, dealers and merchants, electricians, mechanical engineers, machinists, fitters, founders, millwrights, smiths, wire drawers, &c. The subscribers (with one share each) are:—V. Earle, Portchester Lodge, Streatham Common, merchant; H. Trigg, Theydon Bois, Essex, merchant; H. Le Marchant, Stoneleigh, Clapham Common, S.W., merchant; H. Pope, 47, Cranbrook Park, Wood Green, N., secretary; H. C. Mills, 11, Durlston Road, Upper Clapton, N.E., clerk; A. Fichet, 1, Richmond Terrace, Towchester, Northamptonshire, clerk; G. Hickson, 15, Wickham Terrace, Towchester, North-

amptonshire, clerk. The number of directors not to be less than three, nor more than seven; the subscribers are to appoint the first. Qualification £500; remuneration £200 each per annum, and an extra £5 for the chairman. Registered office, 17, Newington Causeway, S.E.

**New Motive Power Syndicate Limited** (50,637).—Registered December 22nd; capital, £15,000 in £1 shares, to enter into an agreement with G. Belcher and the Mutual Exploration Finance and Underwriting Corporation, Limited, to manufacture locomotive and other engines, machines, carriages, bicycles, motors, &c., and to carry on the business of mechanical, manufacturing, electrical and chemical engineers, machinists, and carriage builders. The subscribers (with one share each) are:—J. Solomon, 53, Goodwin Road, Forest Gate, clerk; G. H. Jones, 42, Montpelier Road, Peckham, clerk; H. Hart, 745, Old Kent Road, S.E., manufacturer; S. E. Buttenshaw, 11, Pancras Lane, E.C., secretary; J. Wright, 9, Union Court, E.C., merchant; H. H. S. Andrews, Park Avenue, Tottenham, veterinary; E. Pellatt, 21, Magdalen Road, Dartmouth. The number of directors not to be less than two, nor more than five; qualification, 25 shares; remuneration, £50 each per annum, and £75 for the chairman. Registered by J. Battams, 23, Rood Lane.

**Laurence, Scott & Co., Limited** (50,656).—Registered December 24th; capital, £50,000 in 4,995 shares of £10 each, and 50 founders' shares of £1 each, to acquire the business of Laurence, Scott & Co., Limited (registered in 1888), to adopt an agreement with the said company and its liquidators, to carry on the business of electrical engineers and contractors, and to carry on the business of an electrical company. The subscribers are:—

| | Ordinary. | Founders'. |
|---|---|---|
| R. Laurence, Gothic Works, Norwich, electrical engineer ... ... ... ... | 1 | 21 |
| J. J. Colman, Carrow House, Norwich, manufacturer ... ... ... ... ... | 1 | 17 |
| W. H. Scott, Gothic Works, Norwich, manufacturer ... ... ... ... ... | 1 | 4 |
| C. Willson, Gothic Works, Norwich, engineer | 1 | 2 |
| W. B. Sisling, Gothic Works, Norwich, engineer ... ... ... ... ... ... | 1 | 1 |
| R. Haselwood, Carrow House, Norwich manager ... ... ... ... ... | 1 | ... |
| C. F. Burlingham, Carrow House, Norwich, accountant ... ... ... ... ... | 1 | ... |
| P. E. Laurence, 13, Copthall Court, E.C., stockbroker ... ... ... ... ... | 1 | ... |

The number of directors not to be less than three nor more than eight; qualification, £500; remuneration as the company may decide. Registered Office, Gothic Works, Norwich.

**Westminster Engineering Company, Limited** (50,677).—Registered December 28th; capital £20,000, in £1 shares (12,500 ordinary, 7,000 preference, and 500 founders), to enter into an agreement with J. O. Girdlestone and W. T. Lord, and to carry on the business of electrical and mechanical engineers, manufacturers of and dealers in electric, galvanic, magnetic, telephonic, and other appliances, ironmongers, electric bell manufacturers and fitters, iron merchants, &c. The subscribers (with one share each) are:—J. O. Girdlestone, 16, Davies Street, Berkeley Square, W., electrical engineer; A. G. Way, Stanmer Argyle Road, Ealing, N.W., electrical engineer; G. W. Metcalfe, 22, K. Orchard Street Buildings, Victoria Street, S.W., accountant; W. Meacher, 24, Carleton Road, Tufnell Park, N., architect; W. T. Lord, Stamford Brook Villa, Hammersmith; A. J. Meacher, 24, Carleton Road, Tufnell Park, N., architect; T. E. Way, Stanmer Argyle Road, Ealing, N.W., gentleman. The number of directors not to be less than three, nor more than seven. Qualification £500; remuneration £475 per annum, divisible, to be increased to £1,150 per annum, according to profit. Registered office, 27, Regency Street, Westminster, S.W.

## CITY NOTES.

### West Coast of America Telegraph Co.

MR. J. D. PENDER presided over an extraordinary meeting of the shareholders of the above company, held at Winchester House on Wednesday, and addressing the meeting said that if they referred to the speech he made at the last general meeting, they would see that he then said that the company were unable then to meet all their engagements, but that two companies—the Brazilian and the Eastern—who were interested in that traffic, had made up the deficiency, as the Board were not prepared to carry on the West Coast of America Telegraph Company without balancing the accounts for the year then under review. It was then contemplated that they should go on for another year and see how they got on. He was sorry to say they had only been able to go on for six or seven months before they came to the present date, just before the debenture interest due on the 31st, but the Brazilian Co., which was interested in the traffic, was prepared to meet those coupons. Therefore the debenture holders would not be at any loss for the interest due. In the meantime the Board would consider the position of the company, and shortly—he could not give them the date—they would call the shareholders together, and put some proposition before them. What that proposal would be he could give them no idea of at the present time, but something would have to be done, as the directors were not going to carry on that company as a losing concern. It must in the course of a short time either be wound up, or arrangements made by which they would not have to come before them in the condition they had both at the last general meeting and at the present time. He begged to move the two following resolutions:—"(1) That the directors be, and they are hereby, authorised to create and issue debentures of the company (hereinafter called 'new debentures'), for securing principal sums not exceeding in the aggregate £20,000, and carrying interest at the rate of 5 per cent. per annum, and that the new debentures may be in such form, and may contain such provisions, and may be secured on all or any part or parts of the undertaking, rights, and property of the company, both present and future, in such manner and by such instruments or instrument (including, if thought fit, a trust deed), as the directors may think fit, and that any such instrument may contain such provisions, and be in such form in all respects, as the directors may deem expedient. And that all or any of the new debentures may be issued to such persons or corporations, and either by way of security for any existing or future debts or debt of the company, or at any price or prices, or otherwise, howsoever and generally upon such terms in all respects as the directors may, in their absolute discretion, deem expedient. Provided that every charge which may be given for the purpose of securing the new debentures, or any of them, shall so far as regards any rights or property now subject to the charge created by the company's trust deed of January 1st, 1878, for the purpose of securing the existing debentures of the company of the aggregate nominal amount of £150,000, be subject to, and rank after, the last-mentioned charge." "(2) That subject and without prejudice to the powers given by the last preceding resolution, the directors be, and they are hereby authorised (if they think fit so to do), to further or collaterally secure the repayment of all or any of the moneys borrowed or raised on the security of the new debentures, and the interest thereon, by charging either specifically or otherwise all or any part or parts of the undertaking, rights, or property of the company, whether present or future, by such instruments or instrument, in such form and containing such provisions as the directors may think fit."

MR. WALTERS seconded the resolutions, and they were carried without discussion.

A vote of thanks to the chairman terminated the proceedings.

### British Electric Traction Company, Limited.

SIR C. RIVERS WILSON presided on Tuesday at a confirmatory meeting at Winchester House. The chairman explained that the meeting had been called, in conformity with the provisions of the Companies Acts, to confirm certain resolutions which had been passed at an extraordinary meeting of the company held on the 14th ult. He then proposed that the Crewe Light Railway Order, the Norwich and District Light Railway Order, and the Potteries Light Railway Order be approved, subject to all such conditions, alterations, and variations as the Light Railway Commissioners or the Board of Trade may think fit to make therein.

The EARL OF SUFFOLK seconded the motion, which was carried unanimously.

### The South Staffordshire Tramways Co., Limited.

AN ordinary general meeting of this company was held at Cannon Street, yesterday, for the purpose of receiving the 1895 accounts, the delay in issue of the report being due to the litigation in which the company has been involved. The total receipts for the year amounted to £29,667, being a decrease of £572, the total receipts per car mile being 12·45d. against 11·61d. The total expenditure of the year showed a decrease of £373 1s. 3d. as compared with the previous year.

The CHAIRMAN, in his remarks, spoke of the litigation in which the company had been concerned; he also dwelt upon the improved position of the company up to the end of 1896. In reply to questions, he said that the amount recovered from Mr. Ebbsmith would figure in the next accounts. After addressing the meeting for a few minutes, the chairman proposed the adoption of the report, which was unanimously agreed to.

The chairman then, in an informal way, sketched out a scheme of raising money for the purpose of equipping further portions of the line for electrical working, and also buying the present electrical plant, which is owned and worked by the E.C.C. at a charge of 8d. per car mile. The scheme suggested, the raising of £140,000 in debentures, which would wipe off the present £49,000 5 per cent. debentures, and leave about £90,000 for improving the line and altering the methods of working.

**Madeira Electric Lighting Company, Limited.**—Interest coupons of the debenture bonds, which fell due yesterday, will be paid on and after that date by the Halifax Joint Stock Banking Company, Princes Street, Halifax.

**Stock Exchange Notices.**—Application has been made to the Committee to allow Royal Electric Company of Montreal—10,000 shares of $100 each—to be quoted in the Official List.

**Elmore's American and Canadian Patent Copper Depositing Company, Limited.**—A meeting of this company was held at Leeds yesterday.

**Madras Electric Tramway Company.**—A meeting of this company was held yesterday, but we were informed it was private.

## TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending December 27th, 1896, were £972; week ending December 29th, 1895, £906; increase, £66; total receipts for half-year, 1896, £25,075; corresponding period, 1895, £23,459; increase, £1,616.

The Liverpool Overhead Railway Company. The receipts for the week ending December 27th, 1896, amounted to £1,304; corresponding week last year, £941,; increase, £363.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending December 25th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,992.

## SHARE LIST OF ELECTRICAL COMPANIES.

### TELEGRAPH AND TELEPHONE COMPANIES.

| Present issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1893. | 1894. | 1895. | Closing Quotation, Dec. 22nd. | Closing Quotation, Dec. 30th. | Business done during week ended Dec. 30th, 1896. Highest. | Lowest. |
|---|---|---|---|---|---|---|---|---|---|
| 173,400£ | African Direct Teleg., Ltd., 4 % Deb. ... ... ... | 100 | 4 % | 4 % | 4 % | 100 —104 | 100 —104 | ... | ... |
| 25,000 | Amazon Telegraph, Limited, shares... ... ... ... | 10 | ... | ... | ... | 8½ — 9½ | 8½ — 9½ | ... | ... |
| 1,612,880£ | Anglo-American Teleg., Ltd. ... ... ... ... ... | Stock | £2 11s. | £2 2s. | £2 9s. | 51 — 54 | 51 — 54 | 51½ | 51½ |
| 2,993,560£ | Do. do. 6 % Pref. ... ... ... ... ... | Stock | £5 2s. | £4 4s. | £4 18s. | 95½ — 96½ | 95½ — 96½ | 96⅝ | 95½ |
| 2,993,560£ | Do. do. Defd. ... ... ... ... ... ... | Stock | ... | ... | ... | 9½ — 10 | 9½ — 10½ | ... | ... |
| 120,000 | Brazilian Submarine Teleg., Ltd. ... ... ... ... | 10 | 6½% § | 7 % | 7 % | 14½ — 15½ | 14½ — 15½xd | 15⅛ | ... |
| 75,000£ | Do. do. 5 %, Debs., 2nd series, 1906 ... ... | 100 | 5 % | 5 % | 5 % | 114 —118 | 115 —119 | ... | ... |
| 44,000 | Chili Telep., Ltd., Nos. 1 to 44,000 ... ... ... ... | 5 | ... § | 2½% | 4 % | 3½ — 3⅝ | 3½ — 3⅝ | ... | ... |
| 10,000,000$ | Commercial Cable Co. ... ... ... ... ... ... | $100 | 7 % | 7 % | 7 % | 165 —170 | 160 —170 | ... | ... |
| 224,850 | Consolidated Telep. Const. and Main., Ltd. ... ... | 10/- | 2 % § | 1½% | 1½% | 1/16 — 1/8 | 1/16 — 1/8 | ... | ... |
| 16,000 | Cuba Teleg., Ltd. ... ... ... ... ... ... | 10 | 8 % | 8 % | 8 % | 11½ — 12½ | 11½ — 12½ | ... | ... |
| 6,000 | Do. 10 % Pref. ... ... ... ... ... | 10 | 10 % | 10 % | 10 % | 18½ — 19½ | 18½ — 19½ | ... | ... |
| 12,931 | Direct Spanish Teleg., Ltd. ... ... ... ... ... | 5 | 4 % | 4 % | 4 % | 3½ — 4½ | 3½ — 4½ | ... | ... |
| 6,000 | Do. do. 10 % Cum. Pref. ... ... ... | 5 | 10 % | 10 % | 10 % | 10 — 10½ | 10 — 10½ | ... | ... |
| 30,000£ | Do. do. 4½ % Debs. Nos. 1 to 6,000 ... | 50 | ... | 4½% | 4½% | 107—110% | 107 —110 % | ... | ... |
| 69,710 | Direct United States Cable, Ltd. ... ... ... ... | 20 | 2½% § | 2 % | 2½% | 9½ — 9⅝ | 9½ — 9⅝ | ... | ... |
| 400,000 | Eastern Teleg., Ltd., Nos. 1 to 400,000 ... ... ... | 10 | 6½% § | 6½% | 6½% | 17 — 17½ | 17 — 17½ | 17 7/16 | 17⅛ |
| 70,000 | Do. 6 % Cum. Pref. ... ... ... ... | 10 | 6 % § | 6 % | 6 | 18 — 19 | 18 — 19 | 18⅝ | ... |
| 102,100£ | Do. 5 % Debs., repay. August, 1899 ... ... | 100 | 5 % | 5 % | 5 % | 104 —107 | 104 —107 | ... | ... |
| 1,297,837£ | Do. 4 % Mort. Deb. Stock Red. ... ... | Stock | 4 % | 4 % | 4 % | 127 —130 | 127 —130 | ... | ... |
| 250,000 | Eastern Extension, Australasia and China Teleg., Ltd. ... | 10 | 7 % | 7 % | 7 % | 17 — 17½ | 17 — 17½ | 17½ | 17¼ |
| 54,100£ | { Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 | }100 | 5 % | 5 % | 5 % | 101 —105 | 101 —105 | ... | ... |
| 194,300£ | Do. do. Bearer, 1,050—3,975 and 4,327—6,400 | 100 | 5 % | 5 % | 5 % | 102 —105 | 102 —105 | ... | ... |
| 920,000£ | Do. 4 % Deb. Stock ... ... ... ... ... | Stock | 4 % | 4 % | 4 % | 128 —131 | 128 —131 | 130¼ | ... |
| 80,600£ | { Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343 | }100 | 5 % | 5 % | 5 % | 101 —105 | 101 —105 | ... | ... |
| 107,600£ | Do. do. to bearer, 2,344 to 5,500 | 100 | 5 % | 5 % | 5 % | 102 —105 | 102 —105 | ... | ... |
| 300,000£ | { Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909 | }100 | 4 % | 4 % | 4 % | 107 —110 | 107 —110 | ... | ... |
| 300,000£ | Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | 4 % | 4 % | 4 % | 108 —111 % | 108 —111 % | ... | ... |
| 180,227 | Globe Telegraph and Trust, Ltd. ... ... ... ... | 10 | 4½% § | 4½% | 4½% | 10⅜ — 11½ | 10⅜ — 11½ | 10⅞ | 10 1/16 |
| 180,042 | Do. do. 6 % Pref. ... ... ... | 10 | 6 % § | 6 % | 6 % | 17 — 17½ | 17½ — 17⅝ | 17 3/16 | ... |
| 150,000 | Great Northern Teleg. Company of Copenhagen ... ... | 10 | 8⅝% | 8⅝% | 10 % | 24 — 25 | 24 — 25 | ... | ... |
| 180,000£ | Do. do. do. 5 % Debs. | 100 | 5 % | 5 % | 5 % | 104 —107 | 104 —107 | ... | ... |
| 17,000 | Indo-European Teleg., Ltd. ... ... ... ... ... | 25 | 10 % | 10 % | 10 % | 53 — 56 | 53 — 55 | ... | ... |
| 100,000£ | London Platino-Brazilian Teleg., Ltd. 6 % Debs. ... ... | 100 | 6 % | 6 % | 6 % | 109 —112 | 109 —112 | ... | ... |
| 28,000 | Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ... | 5 | 4 % | 4 % | 4 % | 2 — 2½ | 2 — 2½ | ... | ... |
| 484,597 | National Teleph., Ltd., 1 to 484,597 ... ... ... ... | 5 | 5 % § | 5 % | 5½% | 7⅛ — 7⅜ | 7⅛ — 7⅜ | 7¼ | ... |
| 15,000 | Do. 6 % Cum. 1st Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 17 — 19 | 17 — 19 | ... | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. ... ... ... | 10 | 6 % | 6 % | 6 % | 17 — 19 | 17 — 19 | ... | ... |
| 119,234 | Do. 5 % Non-cum. 3rd Pref., 1 to 119,234 | 5 | 5 % | 5 % | 5 % | 6⅝ — 6¾ | 6½ — 7 | ... | ... |
| 1,100,000£ | Do. 3½ % Deb. Stock Red. ... ... | Stock | 3½% | 3½% | 3½% | 105 —108 | 104 —107 xd | ... | ... |
| 171,504 | Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid | 1 | ... | 4½% | 5 % | 11/16 — 13/16 | 11/16 — 13/16 | ... | ... |
| 100,000£ | { Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000 | }100 | 4 % | 4 % | 4 % | 108 — 111 | 108 —111 | ... | ... |
| 11,839 | Reuter's Ltd. ... ... ... ... ... ... ... | 8 | 0 % | nil | 5 % | 7 — 8 | 7 — 8 | ... | ... |
| 3,381 | Submarine Cables Trust ... ... ... ... ... | Cert. | ... | ... | ... | 138 —143 | 138 —143 | ... | ... |
| 58,900 | United River Plate Teleph., Ltd. ... ... ... | 5 | ... | 3 % | 4 % | 3½ — 3¾ | 3½ — 3¾ | ... | ... |
| 146,732£ | Do. do. 5 % Debs. ... ... ... | Stock | 5 % | 5 % | 5 % | 103 —108 | 103 —105 xd | ... | ... |
| 15,609 | West African Teleg., Ltd., 7,501 to 23,109 ... ... ... | 10 | nil | nil | 4 % | 5 — 6 | 5 — 6 | ... | ... |
| 238,900£ | Do. do. do. 5 % Debs. ... ... ... | 100 | 5 % | 5 % | 5 % | 103 —106 | 103 —106 | ... | ... |
| 30,000 | West Coast of America Teleg., Ltd. ... ... ... ... | 10 | nil | nil | nil | ⅛ — 1½ | 0 — 1 | ... | ... |
| 158,800£ | Do. do. do. 8 % Debs., repay. 1902 | 100 | 8 % | 8 % | 8 % | 95 —101 | 93 — 99 | ... | ... |
| 64,248 | Western and Brazilian Teleg., Ltd. ... ... ... ... | 15 | 2½% | 3 % | 3 % | 8 — 8½ | 8½ — 8⅝ | ... | ... |
| 33,129 | Do. do. do. 5 % Pref. Ord. ... | 7½ | 5 % | 5 % | 5 % | 6½ — 6⅝ | 6½ — 6⅝xd | ... | ... |
| 33,129 | Do. do. do. Def. Ord. ... ... | 7½ | ... | 1 % | 1 % | 1⅝ — 2¼ | 2⅜ — 3 | 2 15/16 | 2 7/16 |
| 165,200£ | Do. do. do. 5 % Debs. "A," 1880 Red. | 100 | 6 % | 6 % | 6 % | 104 —108 | 105 —109 | ... | ... |
| 206,400£ | Do. do. do. do "B," do. | 100 | 6 % | 6 % | 6 % | 104 —108 | 105 —109 | ... | ... |
| 68,221 | West India and Panama Teleg., Ltd. ... ... ... | 10 | ⅛% | ¼% | ⅛% | 1½ — 1⅝ | 1½ — 1⅝ | ... | ... |
| 34,563 | Do. do. do. 6 % Cum. 1st Pref. | 10 | 6 % | 6 % | 6 % | 11½ — 12 | 11½ — 12 | ... | ... |
| 4,669 | Do. do. do. 6 % Cum. 2nd Pref. | 10 | 6 % | 6 % | 6 % | 9½ — 10¼ | 9½ — 10½ | ... | ... |
| 80,000£ | Do. do. 5 % Debs. No. 1 to 1,600 ... | 100 | 5 % | 5 % | 5 % | 109 —112 | 109 —112 | ... | ... |
| 1,777,000$ | Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ... | $1000 | 7 % | 7 % | 7 % | 107 —112 | 107 —112 | ... | ... |
| 154,360£ | Do. do. 6 % Ster. Bonds. ... ... | 100 | 6 % | 6 % | 6 % | 100 —105 | 100 —105 | ... | ... |

### ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | Charing Cross and Strand Electy. Supply ... ... ... | 5 | 4½% | 4½% | 5 % | 9½ — 9¾ | 9½ — 9¾ | ... | ... |
| 10,277 | *Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ... | 5 | 5 % | 5 % | 5 % | 8½ — 8⅝ | 8½ — 8⅝ | ... | ... |
| 60,000 | Do. do. do. 4½ % Deb. Stock Red. ... | Stock | ... | ... | 4½% | 114 —117 | 112 —115 xd | ... | ... |
| 40,000 | City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000 | 10 | ... | 5 % | 5 % | 15½ — 16½ | 15½ — 16½ | ... | ... |
| 40,000 | Do. do. 6 % Cum. Pref., 1 to 40,000 | 10 | 6 % | 6 % | 6 % | 16½ — 17½ | 16½ — 17½ | 17½ | ... |
| 300,000 | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | 5 % | 5 % | 5 % | 128 —133 | 126 —130 xd | ... | ... |
| 22,475 | County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475 | 10 | ... | ... | nil | 8 — 9 | 8 — 9 | ... | ... |
| 20,000 | Do. do. do. 6% Pref., 40,001—50,000 ... | 10 | ... | ... | 6 % | 13⅝ — 14½ | 13⅝ — 14½ | ... | ... |
| 10,000 | Do. do. iss. at 2 pm., all paid ... ... | 10 | ... | ... | ... | 7⅝ — 8½ | 7⅛ — 8½ | ... | ... |
| 49,900 | *Metropolitan Electric Supply, Ltd., 101 to 50,000 ... | 10 | 2½% | 3 % | 4 % | 13 — 14 | 12½ — 13½ | 13⅛ | ... |
| 12,500 | Do. Ord., 50,001—62,500, iss. at £2 prem., £1 paid | 10 | ... | ... | ... | 6½ — 7 | 6½ — 7 | ... | ... |
| 150,000£ | Do. 4½% first mortgage debenture stock ... ... | ... | 4½% | 4½% | 4½% | 121 —124 | 119 —122 xd | 123½ | ... |
| 6,452 | Notting Hill Electric Lightg. Co., Ltd. ... ... ... | 10 | ... | 1 % | 2 % | 10 — 11 | 10 — 11 | ... | ... |
| 19,980 | *St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080 | 5 | 4½% | 6½% | 7½% | 12 — 13 | 12 — 13 | ... | ... |
| 20,000 | Do. do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 9½ — 10½ | 9½ — 10½ | ... | ... |
| 50,000 | Do. do. 4 % Deb. stock Red. ... | Stock | ... | ... | ... | 106 —109 | 104 —107 xd | ... | ... |
| 67,900 | *Westminster Electric Supply Corp., Ord., 101 to 60,000 ... | 5 | 4 % | 5 % | 7 % | 11 — 12 | 11 — 12 | ... | ... |

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

## SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

| Present Issue. | NAME, | Stock or Share ‡ | Dividends for the last three years. 1893. | 1894. | 1895. | Closing Quotation Dec. 22nd. | Closing Quotation, Dec. 30th. | Business done during week ended Dec. 30th, 1896. Highest. | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 90,000 | Brush Elecl. Engng. Co., Ord., 1 to 90,000 ... ... ... | S | 5 % § | 2½% | ... | ¾ – 1 | ¾ – 1 | ... | ... |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 | S | 6 % § | 3 % | ... | 1 – 1¼ | 1 – 1¼ | ... | ... |
| 125,000 | Do. do. 4½ % Perp. Deb. Stock. ... ... | Stock | 4½% | 4½% | ... | 110 –113 | 110 –113 | ... | ... |
| 76,770 | Do. do. 4½% 2nd Deb. Stock Red. ... | Stock | ... | ... | ... | 96 –100 | 94 – 98 xd | ... | ... |
| 9,104 | Central London Railway, Ord. Shares ... ... ... | 10 | ... | ... | ... | 9⅜ – 10¼ | 9⅜ – 10¼ | ... | ... |
| 207,649 | Do. do. do. £4 paid ... ... | 10 | ... | ... | ... | 3⅞ – 4⅛ | 3⅞ – 4⅛ | ... | ... |
| 630,000 | City and South London Railway ... ... ... ... | Stock | 1½% | 1½% | 1⅝% | 53 – 55 | 54 – 56 | 55 | ... |
| 28,180 | Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180 | 5 | 3 % § | *nil* | *nil* | 1⅜ – 2¼ | 1⅜ – 2¼ | ... | ... |
| 89,261 | Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261 | 5 | 7 % | 5 % | 5 % | 1⅜ – 2¼ | 1⅜ – 2¼ | ... | ... |
| 17,139 | Do. do. do. "A" Shares 01—017,139 | 5 | 7 % | 5 % | 5 % | 3 – 4 | 3 – 4 | ... | ... |
| 100,000 | Do. do. do. 4½% Deb. Stock Red. ... | Stock | ... | 4½% | 4½% | 103 –106 | 102 –105 xd | ... | ... |
| 110,000 | Electric Construction, Ltd., 1 to 110,000 ... ... ... | 2 | *nil* | *nil* | 5 % | 1⅜ – 1⅝ | 1⅜ – 1⅝ | ... | ... |
| 12,845 | Do. do. 7 % Cum. Pref., 1 to 12,845 ... | 2 | 7 % | 7 % | 7 % | 2½ – 3 | 2½ – 3 | ... | ... |
| 91,195 | Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000 ... ... | 2 | *nil* | *nil* | ... | ⅜ – ½ | ⅜ – ½ | ... | ... |
| 69,385 | Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ... | 2 | *nil* | *nil* | ... | ¼ – ½ | ¼ – ½ | ... | ... |
| 9,600 | Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ... | 10 | *nil* | *nil* | 10½% | 10½ – 11½ | 10½ – 11½ | ... | ... |
| 10,000 | Henley's (W. T.) Telegraph Works, Ltd., Ord. ... .. | 10 | 5 % | 6 % | 8 % | 17½ – 18½ | 17½ – 18½ | ... | ... |
| 3,000 | Do. do. do. 7% Pref. ... ... | 10 | 7 % | 7 % | 7 % | 18½ – 19½ | 18½ – 19½ | ... | ... |
| 50,000 | Do. do. do. 4½ Mort. Deb. Stock | Stock | ... | ... | 4½% | 109 –114 | 109 –114 | ... | ... |
| 50,000 | India-Rubber, Gutta Percha and Teleg. Works, Ltd. ... | 10 | 12½% | 10 % | 10 % | 20½ – 21½ | 20½ – 21½ | 21¼ | 21⅛ |
| 300,000 | Do. do. do. 4 % 1st Mort. Debs. | 100 | ... | ... | ... | 105 –108 | 105 –108 | ... | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | 1 % | 1½% | 2⅞% | 14¼ – 14½ | 14 – 14½ | ... | ... |
| 10,000 | † Do. do. Pref., £10 paid ... ... | 10 | 5 % | 5 % | 5 % | 17 – 17½ | 17 – 17½ | ... | ... |
| 37,350 | Telegraph Constn. and Maintce., Ltd. ... ... ... | 12 | 20 % | 20 % | 15 % | 39 – 42 | 39 – 42 | ... | ... |
| 150,000 | Do. do. do. 5 % Bonds, red. 1899 | 100 | 5 % | 5 % | 5 % | 104 –107 | 104 –107 | ... | ... |
| 54,000 | Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ... | 10 | ... | ... | ... | 7⅞ – 8½ | 7½ – 8 | ... | ... |

Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
CROMPTON & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%

### LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7⅞, £5 (fully paid) 9¼.
Electric Construction Corporation, 6 % Debentures, 104—106.
House-to-House Company (£5 paid), 4½—5.
Do. do. 7 % Preference, of £5, 8½—9.
Do. do. 4½% Debentures of £100 109—111.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 10—10½; 1st Preference Cumulative 6 %, £5 (fully paid), 8¼—8¾.
London Electric Supply Corporation, £5 Ordinary, 1—1¼.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7½—8.

* From Birmingham Share List.

Bank rate of discount, 4 per cent. (October 22nd, 1896).

## REVIEW.

*Electric Street Railways.* By E. J. HOUSTON and A. E. KENNELLY. New York: The W. J. Johnston Company. 1896.

In their preface to this book, the authors express themselves as writing the work—which forms one of their electro-technical series—for perusal by the general public: and a large sinister-visaged owl appears on the outside front cover to give the non-technical reader at the outset a flattering idea of the wisdom he will have acquired after finishing the book. It is not saying very much of the authors to state that they have written numerous pamphlets and handbooks relative to the elementary study of electrical engineering: the usual run of such publications savour too much of the mere bookmaker, and, although few realise it, the task is extremely hard of properly explaining the A B C of a science or art to those wholly ignorant thereof. However, both our present authors have made their names altogether outside the field of literature: and their efforts to enlighten the general public will therefore carry the more weight.

We do not think that they or any others have succeeded—or can succeed—in the brief scope of a handbook, a lecture or conversation, in making our dear friends, the general public, fairly well acquainted with "the leading principles of electric traction without any previous knowledge of electro-technics": our acquaintance with the ordinary individual only leads us to feel the utter hopelessness of attempting without the aid of object lessons, much time and no little patience, to make him understand the theory and practice of electric traction, even in the case of such presumably (!) acute and unprejudiced persons as town councillors and tramway directors.

Messrs. Houston and Kennelly's book will doubtless be read by many who have not the least idea of electric traction, and such persons will—also doubtless—obtain no small amount of information thereupon. But it will be ill-digested and probably misunderstood: many points require careful elucidation by a skilled expert, while both before and after perusal the reader ought to actually *see and watch* an electric tramway at work if he is to properly benefit by it. We, therefore, feel inclined to say that this book should first be taken up by electrical engineers, and used by them as a handbook for explaining to outsiders the problems and knotty points of electric traction work.

However simply and clearly written, it will be found too technical for easy grasp by the outsider, though apparently well adapted for text-book use in the hands of those who thoroughly understand the art.

Given these conditions, we can speak favourably of the book, although much of it again will be thought elementary by the average electrical engineer. It is of convenient size for reading and for the pocket; has plenty of illustrations, and deals systematically and clearly with the entire subject. Of the 16 chapters in the book, those which contain the most novel and useful information are the two that treat of car heating and the controller mechanism: the latter are especially well described, all the combinations represented by the different contacts being traced out in detail.

The introduction is largely filled with a hydraulic analogy of electric flow in a circuit, and is good so far as it goes—which is quite far enough, seeing that on a later page the same idea is pushed to an extent that might give rise to erroneous impressions. Chapter II., on the early history of electric traction, has no great interest or novelty beyond the fact of unearthing a so-called pioneer called George Green, who has probably never been heard of before, and who appears to have been merely one of a thousand like himself—poor, unknown, and inventive—as a rule, three excellent qualities for ill-success in life. He does not seem to have done anything very startling either. Chapter III. deals with the units of work and activity, also with the idea of an electric circuit, again introducing the analogy of "watermotive" force from hydraulics. This is surely defective seeing that the pump or hydraulic generator, as a rule, only runs when the water motor is in action; a dynamo

generator runs whether the electric motor is at work or not. The pressure is maintained in the one case at the stop valve, in the other at the dynamo or switch terminals. Resistance, counter E.M.F., output, and feeders, are also discussed in this chapter.

Chapter IV. contains a good description of the electric motor and its attendant details as applied to street tramway purposes; and Chapter V. deals similarly with car bodies, trucks, and gear (gear "cores" for "covers" is a curious misprint), and both these chapters are to be commended, though the authors are a little wide of the mark in saying that double decked cars are not in use on overhead trolley lines. Chapters VI. and VII. deal with car heaters and controllers. Chapter VIII. with trolleys; IX. with overhead construction; X. refers to track construction from a distinctively American standpoint, though after all there is not much to choose between the best built track in England or America, while the bad track is equally vile in both countries—here from bad design, there from rough workmanship.

Chapter XI. deals with the effects of electrolysis in a fashion that might have passed current some years ago, but which need not be regarded in this country where Board of Trade rules are enforced. Switchboards, generators, and power house details generally are next discussed, briefly but clearly, followed by a short but important chapter on cost of operation and maintenance. The authors quote as reliable a report dated 1894 to the effect that on 213 American electric street railways having a total length of 5,120 miles, the operating expenses averaged 62·8 per cent. of the gross receipts, fixed charges being 22·9 per cent., so that a net profit remained of 14·3 per cent. The authors' estimate of 20 kilowatts in the power house for each car on line seems rather high for average conditions; two-thirds or even one-half this allowance ought to be sufficient in ordinary service where the station is properly designed and economically worked.

Chapter XV. which deals with storage battery systems, is very complete, and well-written. We are surprised, however, to note so little criticism of what experience has long since shown to be the fundamentally weak points in self-contained battery cars.

The last chapter is entitled "Electric Locomotives," and is rather out of place in a book of the title at the head of this notice. It discusses—without giving any new information or comment—matters like the Boynton bicycle railroad, that curious second cousin or half-brother of the Behr Lartigue system, and equally needing sound mechanical work to bring it within the range of practical high speed railroading. The only disadvantage that the authors can see in it—or at any rate the only one they mention—is that there are only seats for two in the width of the car. Some people wouldn't object to this at all. The Baltimore and Ohio locomotives fill up the rest of the chapter.

As a handy text book—ranking, however, considerably behind Crosby and Bell's work for technical value—we can recommend this work on the whole as being well worth the money asked for it.

## NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

### NEW PATENTS.—1896.

[*Compiled expressly for this journal by* W. P. THOMPSON & Co., *Electrical Patent Agents, 322, High Holborn, London, W.C., to whom all inquiries should be addressed.*]

28,573. "Improved method of and means for extinguishing the 'arc' formed in large high pressure electrical circuit interrupters or switches." L. ANDREWS. Dated December 14th.

28,575. "Improvements in and in connection with glasses, globes, chimneys and the like for use with gas, oil, and electric light." W. SHARP. Dated December 14th.

28,578. "Improvements in the bonding of rails used for electrical railways or tramways." R. E. B. CROMPTON. Dated December 14th.

28,609. "Improved electric device for showing the relation of oxygen and nitrogen in mines." L. COHN. Dated December 14th. (*Complete.*)

28,610. "Improvements in electric signalling apparatus for fire damps." L. COHN. Dated December 14th. (*Complete.*)

28,612. "Improvements in or relating to telephonic systems and in apparatus employed therein." A. J. BOULT. (La Societe Anonyme de Telephone Privee, Belgium.) Dated December 14th.

28,663. "Improvements in the method of and means for protecting electric or other lamps when placed in dangerous positions especially from explosive vapours or the like." W. R. HARRISON and P. T. RUNTON. Dated December 15th.

28,678. "Certain improvements in pendants for gas, electric, oil, and other lights." H. HATELEY. Dated December 15th.

28,688. "Improvements in incandescence electric lampholders." G. BYNG. Dated December 15th.

28,704. "New and improved switches for electric currents." W. R. RAWLINGS and J. J. RAWLINGS. Dated December 15th.

28,723. "Improvement in secondary batteries for electricity." J. SCHUIL. Dated December 15th.

28,725. "Improvements in or connected with prepayment meters for gas or other fluid and electricity." W. WEBBER. Dated December 15th.

28,736. "Improvements in direct current dynamo electric generators." R. BELFIELD. (B. G. Lamme, United States.) Dated December 15th.

28,761. "An improved electrical brake for vehicles." E. GROSZ. Dated December 15th. (*Complete.*)

28,764. "Improvements in apparatus for use in electrolysis more especially intended for use in the electrolysis of zinc chloride." F. HURTER and the UNITED ALKALI Co., LTD. Dated December 15th.

28,845. "Improvements in electrical apparatus for firing ordnance." F. WELDON. Dated December 16th.

28,851. "Improvements in electrical make-and-breaks." H. H. LEIGH. (C. Milde, Sons & Co., France.) Dated December 16th.

28,884. "A system of electric distribution for combined lighting and traction plants." A. B. BLACKBURN and W. L. SPENCE. Dated December 16th.

28,955. "Improvements in means of telegraphing or telephoning without wires." A. C. BROWN and G. R. NEILSON. Dated December 17th.

28,973. "Improvements in and relating to alternating electric current transformers." J. A. MCMULLEN. Dated December 17th.

29,040. "Improvements in means for automatically holding taut the communicating or conducting cord or chain of electrically driven vehicles." J. ENTWISLE. (L. D. Beffa, Italy.) Dated December 18th. (*Complete.*)

29,081. "Improvements in incandescent electric lamps." W. E. GIBSON. Dated December 18th.

29,087. "Improved electrical low water alarm or indicator for steam boilers." T. HUGHES. Dated December 18th.

29,107. "Telephone exchange." M. F. HILL. Dated December 18th. (*Complete.*)

29,120. "Improvements in and relating to conduits for electrical traction." J. E. WALLER. Dated December 18th.

29,121. "Improvements in electrical fittings for conduits adapted to electrical traction." J. E. WALLER. Dated December 18th.

29,191. "Improvements in or relating to effecting electrical communication on railway trains." F. J. LONGTON. Dated December 19th.

29,226. "Improvements in dynamo-electric machines." H. H. LAKE. (Cie de l'Industrie Electrique, Switzerland.) Dated December 19th.

29,227. "Improvements in electric telegraphy." C. R. VON BLUMENCRON and B. SCHOFFLER. Dated December 19th.

### ABSTRACTS OF PUBLISHED SPECIFICATIONS.

[*Copies of any of these Specifications may be obtained of* Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., *price, post free,* 8½*d. (in stamps).*]

#### 1895.

13,961. "Improved connector for the rails of electric tramways and railways." H. H. LAKE (Compagnie de l'Industrie Electrique; Geneva (Usine de Secheron), Switzerland.) Dated July 22nd, 1895. Rail bonds for use in electric railways are made of conductors with two end pieces, which are passed into holes in the rail ends and expanded by conical pins.

13,695. "Improvements in portable electrical railway carriage and other roof lamps." H. W. HEADLAND. Dated July 17th, 1895. Relates to railway carriage and like roof lamps. An accumulator is fitted in a round casing, which is detachably mounted on a base carrying the lamp. The bottom of the casing is fitted with contacts and the base with contacts also. The circuit is completed when the parts are in position by a switch, which may be turned by a rod from below or a rod from above. The casing and the box are preferably secured by bayonet joints, and rubber washers may be arranged to prevent vibration.